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TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1908.

No. 830.

MINNESOTA STATE LIBRARY

LEEDS AND CATLIN COMPANY, PETITIONER,

vs.

VICTOR TALKING MACHINE COMPANY AND UNITED STATES GRAMOPHONE COMPANY.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT.

PETITION FOR CERTIORARI FILED MAY 21, 1908.
CERTIORARI AND RETURN FILED JUNE 11, 1908.

(20,707.)

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(20,707.)

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1907.

No. 307.

LEEDS AND CATLIN COMPANY, PETITIONER,

vs.

VICTOR TALKING MACHINE COMPANY AND UNITED STATES GRAMOPHONE COMPANY.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT.

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United States Circuit Court of Appeals for the Second Circuit.

THE VICTOR TALKING MACHINE COMPANY and THE UNITED STATES GRAMOPHONE COMPANY, Complainants-Appellees,

vs.

THE LEEDS & CATLIN COMPANY, Defendant-Appellant.

Transcript of Record.

Appeal from the Circuit Court of the United States for the Southern District of New York.

Printed under the Direction of the Clerk.

Circuit Court of the United States.

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on Berliner Gramophone Patent No. 534543. 2

VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

To the Honorable Judges of the Circuit Court for the United States for the Southern District of New York: 3

The Victor Talking Machine Company, a corporation duly organized and existing under the laws of the State of New Jersey, having its principal office in the City of Camden, State of New Jersey, and the United States Gramophone Company, a corporation duly organized and existing under and by virtue of the laws of the State of West Virginia, having its principal office in Harper's Ferry, State of West Virginia, bring this, their bill of complaint, against the Leeds & Catlin Company, a corpora-

4 tion organized and existing under the laws of the State of New York, and having its office and principal place of business in the City of New York, State of New York, within the Southern District of New York.

And thereupon your orators complain and say:

1. That Emile Berliner, of the City of Washington, District of Columbia, was the original, first and sole inventor of certain new and useful improvements in gramophones, being improvements relating to recording and reproducing speech and other sounds, which improvements were not known or used by others in this country before his invention
5 thereof, and were not patented or described in any printed publication in this or any foreign country before his invention thereof, and was not in public use or on sale in the United States for more than two years prior to his application for a patent therefor, and which had not been abandoned.

2. Your orators further show unto your Honors that the said Emile Berliner, being as aforesaid the first inventor and discoverer of the said new and useful improvements in gramophones or improvements relating to recording and reproducing speech and other sounds, did, on the thirteenth day of March, 1892, duly make application to the Honora-
6 ble Commissioner of Patents at Washington, D. C., for letters patent of the United States for the said invention, and on the said date filed his said application with the said Honorable Commissioner of Patents in due and proper form, and thereafter duly and fully prosecuted said application.

3. Your orators further show that the said Emile Berliner being then the sole and exclusive owner of the said invention, and of all letters patent of the United States to be issued therefor, did during the pendency of the said application, by instrument

in writing duly executed the twenty-ninth day of January, 1895, and recorded at the Patent Office at Washington, D. C., in Liber C 51, page 185, etc., of Transfers of Patents, assign, sell and set over unto your orator, the United States Gramophone Company, the exclusive and entire right, title and interest in and to the said invention, and in and to all letters patent to be issued therefor, and all rights of the said Berliner therein and thereunder whatsoever, as by reference to the said instrument, or a duly authenticated copy thereof, in Court to be produced, will more fully and at large appear. 7

4. Your orators further show that upon the said application of the said Emile Berliner, letters patent of the United States were issued in the name of the said Emile Berliner to your orator, the United States Gramophone Company, as assignee, in due form of law, in the name of the United States of America, under the seal of the Patent Office of the United States, signed by the Secretary of Interior, and countersigned by the Commissioner of Patents of the United States, and duly delivered, bearing date the nineteenth day of February, 1895, and numbered 534543, whereby there was granted and secured to your orator, the United States Gramophone Company, its successors and assigns, for the term of seventeen years from the date of said letters patent, and within the United States and its Territories, the full and exclusive right and liberty of making, constructing, using and vending the said invention and improvements, as set forth in the said letters patent, a duly certified copy of which is ready here in Court to be produced, and by virtue whereof, and of the said assignment, your said orator, the United States Gramophone Company, became the sole owner of all rights and privileges, granted and secured, by the said letters patent, and of all rights of the said Emile Berliner in the prem- 8 9

10 ises, a copy of said Letters Patent No. 534543 being hereto annexed and marked Exhibit A.

5. Your orators further show unto your Honors that by agreement dated the second day of September, A. D. 1895, and recorded in the United States Patent Office in Liber S 52, page 207, etc., your orator, the United States Gramophone Company, as licensor, made and entered into an agreement with William C. Jones, of the City of New York, State of New York, as licensee, subject to the conditions therein contained, by which said Jones acquired as licensee the sole and exclusive right to manufacture, sell, lease and deal in, in the United States, the said
11 invention hereinbefore referred to, patented by Letters Patent No. 534543, dated February 19, 1895, together with other inventions and letters patent issued to the said Emile Berliner, assignor to said United States Gramophone Company, relating to sound recording and reproducing with the right to assign the same to others. That by agreement also dated the second day of September, A. D. 1895, between the said Emile Berliner and the said William C. Jones, and recorded in the Patent Office of the United States in Liber S 52, page 214, etc., the said agreement above noted was *inter alia* confirmed by the said Emile Berliner unto the said William C. Jones.

12 That by agreement dated the fourth day of October, A. D. 1895, between the said United States Gramophone Company and the said William C. Jones, recorded in the said Patent Office at Washington, D. C., in Liber S 52, page 216, etc., the said agreement of September 2, 1895, between the same parties was modified, in matters relative to the payment of royalty.

6. And your orators further show unto your Honors that by declaration of trust dated the fifteenth day of October, A. D. 1895, recorded in the Patent

Office at Washington, D. C., in Liber S 52, page 219, 13
etc., and by agreement dated the first day of November, A. D. 1895, recorded in the said Patent Office at Washington, D. C., in Liber P 52, page 326, etc., the said William C. Jones transferred and assigned to the Berliner Gramophone Company, a corporation duly organized and existing under the laws of the State of Virginia, having its principal office in the City of Roanoke, State of Virginia, its successors and assigns, his entire right, title and interest as sole and exclusive licensee in and to the said Letters Patent No. 534543, and in and to the said invention therein described and claimed, and in and to the aforesaid agreements, and in and to all inventions, letters patent and rights therein and thereunder. 14

7. And your orators further show, that by agreement dated the twenty-eighth day of September, 1901, the said Berliner Gramophone Company, being then the sole owner of the said exclusive license to manufacture, sell, lease and deal in the said invention and inventions, did grant and convey, assign and set over unto Eldridge R. Johnson, of the City of Philadelphia, State of Pennsylvania, the said exclusive license, and all its rights therein and thereunder, to manufacture, sell, use and deal in the said invention and inventions, with the right to the said Johnson to assign the same unto your orator, 15
the Victor Talking Machine Company.

8. Your orators further show unto your Honors that by agreement dated the fifth day of October, 1901, the said Eldridge R. Johnson, being then the sole owner of the said exclusive license to manufacture, sell and deal in the said invention and inventions, did grant and convey, assign and set over unto your orator, the Victor Talking Machine Company, a corporation organized and existing under the laws of the State of New Jersey, the said exclu-

16 sive license and all his rights therein and thereunder to manufacture, sell and use and deal in the said invention and inventions, and all his rights and remedies for infringement of the said patent occurring during the period of the ownership by said Eldridge R. Johnson, of said exclusive license and rights.

9. And your orators further show unto your Honors that by virtue of the premises your orator, the United States Gramophone Company, is now, and has been at all times since the date of the said assignment to it, the sole and exclusive owner of the said Letters Patent No. 534543, and that
17 your orator, the Victor Talking Machine Company, is now, and has been at all times since the date of the said agreement with it, and the said transfers and assignments of the said rights to it, the sole and exclusive licensee as aforesaid, under the said Letters Patent No. 534543, for the manufacture and sale of said invention patented in said letters patent, throughout the United States. Your orators show unto your Honors that they are now the sole and exclusive owners of the legal and equitable title in and to the said Letters Patent No. 534543, and in and to the improvements therein contained and of all rights of action thereto pertaining, as will more fully and at large appear by reference to the
18 said agreements and assignments, all of which will in Court be produced.

10. And your orators further show unto your Honors that they have expended large sums of money in practicing said invention and improvements patented in the said Letters Patent No. 534543, and in introducing the same into public use, and the same are of great commercial value and practical utility; that a great public interest has been manifested therein, and a large demand created for apparatus constructed in accordance with

or embodying the same, which demand your orators are ready and able to supply; that the public generally, in all parts of the United States have recognized and acquiesced in the facts that the said Emile Berliner was the first and original inventor of the said invention, and that the Patent No. 534543 is good and valid, that the public have also acknowledged the claims of your orators to the exclusive rights of the said invention under said patent; and that but for the infringements and wrongs hereinafter complained of and of a few recent infringements encouraged by the unlawful acts of this defendant, your orators would be now in peaceful possession and enjoyment of the said letters patent and invention, and of the income derivable therefrom; and that your orators and their predecessors in title have never acquiesced in any infringements of their rights in the premises at any time. 19 20

11. Yet, as your orators are informed and believe and further show unto your Honors, that the said Leeds & Catlin Company the said defendant herein named, well knowing all the facts herein set forth, but contriving to injure your orators and deprive them and each of them, of the benefits and advantages which might and otherwise would accrue to them, and each of them, from said patented devices, methods and things, have made, sold and used, and are now making and selling and using. apparatus and things relative to sound recording or reproducing, having and containing the devices and things patented in said Letters Patent No. 534543, particularly in claims numbered 5, 32, 35, and employing methods covered by the said Letters Patent, or in all substantial respects the same, the exclusive right to make, use and vend which to others to use is legally vested in your orators. 21

22 12. And your orators further show unto your Honors that notwithstanding the fact that the said defendant has been duly notified by your orators of your orators' rights in the premises, and of the fact that the said defendant was infringing the said Letters Patent of your orators, and that the said defendant should desist from such infringements, the said defendant has continued, and is still continuing, to the great and irreparable damage and injury of your orators, the manufacture, sale and use of the said infringing devices and things.

13. And your orators further show that they
23 have given notice to the public that the said invention is patented and have affixed, or caused to be affixed, to all apparatus and devices manufactured and sold under the authority of your orators the word "Patented," together with the day and year of the grant of the said patent, of which notice the said defendant has had full knowledge.

14. And so it is, may it please your Honors, that the said defendant, as your orators are informed and believe, without the license of your orators, or any of them, and without any license whatsoever, against the will of your orators, and in violation of their rights, has made and sold, and intends to con-
24 tinue to make and sell, within the Southern District of New York, and elsewhere within the United States, said patented devices and things, each having and containing the said patented features, substantially the same in all material respects in construction, operation and effect as in your orators' said letters patent mentioned, and employing methods covered by said letters patent; and that the said defendant is largely advertising said infringements, to the great damage and injury of your orators, and

that the said defendant refuses to pay unto your orators any of the profits which said defendant has made by such unlawful manufacture and sale or to desist from the further infringement of the said letters patent, though requested so to do, all of which acts and doings are in violation of the exclusive rights and privileges so, as aforesaid, vested in your orators under and by virtue of the said letters patent, are contrary to equity and good conscience, tend to the manifest injury of your orators in the premises, and will, (if said defendant is allowed to continue said infringements, irreparably damage and injure your orators, and each of them, depreciate or destroy the value of the exclusive franchises to which your orators are entitled under the patent aforesaid, and will deprive your orators of the benefits and advantages for the loss of which there exists no adequate legal remedy.

And your orators, therefore, pray as follows:

I. That the said defendant be required by decree of this Honorable Court to account for and pay over to your orators such gains and profits as have accrued or arisen, or been earned or received by the said defendant, and all such gains and profits as would have accrued to your orators, but for the unlawful doing of said defendant and all damages your orators have sustained thereby.

II. That the said defendant may be compelled, by the order of this Honorable Court, to deliver up to the judicial custody for destruction, in manner to be provided for in said order, all infringing apparatus and sound records, in the possession of or under the control of said defendant.

III. That the defendant, its associates, attorneys, servants, clerks, agents and workmen, may be perpetually enjoined and restrained, by a writ of in-

28 junction issuing out of and under the seal of this Honorable Court, from directly or indirectly making or causing to be made, using or causing to be used, selling or causing to be sold. any machine or apparatus or sound record, embodying or constructed or operated in accordance with the invention or improvements set forth in the letters patent aforesaid.

IV. That your Honors will grant unto your orators a preliminary injunction, issuing out of and under the seal of this Honorable Court, enjoining and restraining the said defendant, its associates, servants, clerks, agents and workmen, to the same
29 purport, tenor and effect as hereinbefore prayed for with regard to said perpetual injunction; and

V. That the defendant be decreed to pay the costs of this suit; and

VI. That your orators may have such other and further relief as the equity of the case may require.

To the end therefore, that the defendant may, if it can, show why your orators should not have the relief prayed for, and may full, true and direct answer make, but not under oath (answer under oath being expressly waived), according to the best and utmost of its knowledge, information, remem-
30 brance and belief, to the several matters hereinbefore averred and set forth, as fully and particularly as if the same were repeated paragraph by paragraph, and said defendant thereto severally and specifically interrogated, may it please your Honors to grant your orators a writ of *subpoena ad respondendum* issuing out of and under the seal of this Honorable Court, directed to said defendant, the Leeds & Catlin Company, commanding it to appear and make answer to this bill of complaint, and

to perform and abide by such order and decree as 31
to this Court may seem just.

And your orators will ever pray.

HORACE PETTIT,
Of Counsel for Complainants.

July 11th, 1904.

Stimson and Williams,
Solicitors for Complainant,
55 Liberty Street,
New York City.

State of Pennsylvania, }
City and County of Philadelphia, } ss.:

Eldridge R. Johnson, being duly sworn, deposes 32
and says that he is the President of the Victor Talking Machine Company, one of the complainants named in the foregoing bill; that he has read the same and knows the contents thereof, and that the same is true of his own knowledge, save of the matters therein stated to be alleged upon information and belief, and that as to those matters he believes it to be true.

ELDRIDGE R. JOHNSON.

Sworn to and subscribed before me this }
11th day of July, A. D. 1904. }

John B. Rutherford,
[SEAL.] Notary Public, 33
My Commission expires Feb. 27, 1905.

[Bill of complaint filed July 12, 1904.]

34 CIRCUIT COURT OF THE UNITED STATES.

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company, Complainants, vs. LEEDS & CATLIN COMPANY, Defendant.	In Equity. No. 8797. Patent No. 534543.

35

The answer of the defendant above-named to the bill of complaint of the complainants above-named.

To the Honorable, the Judges of the Circuit Court of the United States for the Southern District of New York:

This defendant, now and at all times hereafter saving and reserving to itself all benefit and advantage of exception which can or may be had to the errors, uncertainties and insufficiencies in said complainants' bill of complaint, for answer thereunto says:

36 First. Defendant has no knowledge or information sufficient to form a belief as to whether the Victor Talking Machine Company ever was or is a corporation organized or existing under the Laws of the State of New Jersey, or having an office in the City of Camden, State of New Jersey; or whether the United States Gramophone Company ever was or is a corporation organized or existing under or by virtue of the Laws of the State of West Virginia, or having an office in Harper's Ferry, State of West Viginia, and leaves complainants to make such proof thereof as they may be advised is

material or necessary. Defendant admits that it 37
is now and was at the time of the filing of the bill of complaint herein a corporation organized and existing under the Laws of the State of New York, and having its office and principal place of business in the City of New York, State of New York, within the Southern District of New York.

Second. Upon information and belief, defendant denies that Emile Berliner was the original or first or sole inventor of the alleged improvents in gramophones, or improvements relating to recording and reproducing speech and other sounds mentioned in said bill; and denies that said alleged improvements were new or useful when, as alleged in said bill, they 38
were invented by said Emile Berliner; and denies that said alleged improvements were not known and were not used by others in this country before the alleged invention thereof by said Emil Berliner; and denies that said alleged improvements were not patented and were not described in any printed publication in this or any foreign country before his alleged invention thereof; and denies that said alleged improvements were not in public use and were not on sale within the United States for more than two years prior to his application in the United States for a patent therefor; and denies that said alleged improvements had not been abandoned 39
at the time mentioned in said bill.

Third. Defendant denies that the said Emile Berliner was the first inventor or discoverer of the said alleged new and useful improvements in gramophones, or improvements relating to recording and reproducing speech and other sounds; and denies that it has any knowledge or information sufficient to form a belief as to whether said Berliner made application for letter patent of the United States for said invention to the Commissioner of Patents or otherwise, on March 13, 1892, or at any other

40 time, or whether said Berliner ever filed such an application with the Commissioner of Patents or ever prosecuted such an application, and leaves complainants to make such proof thereof as they may be advised is material or necessary.

Fourth. Defendant denies that said Berliner ever was the sole or exclusive owner of the said alleged invention or ever owner or was entitled to any letters patent of the United States to be issued therefor, and denies that it has any knowledge or information sufficient to form a belief as to whether, during the pendency of said application or at any time, by instrument in writing or otherwise ex-
41 ecuted January 29, 1895, or at any other time, the said Berliner sold, assigned, transferred or set over unto the United States Gramophone Company, the exclusive or entire or any right, title or interest in or to the said alleged invention, or in or to the letters patent to be issued therefor, or all or any rights of the said Berliner therein or thereunder, and leaves complainants to make such proof thereof as they may be advised is material or necessary.

Fifth. Defendant admits that Letters Patent of the United States Numbered 534543 and bearing date February 19, 1895, were issued in the name of Emile Berliner, but defendant denies that it has
42 any knowledge or information sufficient to form a belief as to whether the said letters patent were issued upon the application of the said Berliner, or whether the United States Gramophone Company was the assignee of the entire or any right, title or interest therein or thereunder, or whether the said letters patent were issued in due form of law, or in the name of the United States of America, or under the seal of the Patent Office of the United States, or were signed by the Secretary of the Interior, or countersigned by the Commissioner of Patents of the United States, or were ever delivered

and leaves complainants to make such proof thereof as they may be advised is material or necessary; and defendant denies that by said letters patent there was granted or secured to the United States Gramophone Company or to its successors or assigns for the term of seventeen years, or for any term, within the United States and its territories or any part thereof, the full or exclusive or any right or liberty of making, constructing, using or vending the said alleged invention or improvements, and defendant denies that it has any knowledge or information sufficient to form a belief as to whether the United States Gramophone Company by virtue thereof, or by virtue of the said alleged assignment or otherwise ever become the owner, sole or other, of all or any rights or privileges alleged to have been granted and secured by the said letters patent, or of all or any rights of the said Emile Berliner in the premises, and leaves complainants to make such proof thereof as they may be advised is material or necessary. 43 44

Sixth. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether by agreement dated September 2, 1895, or otherwise the United States Gramophone Company as licensor or otherwise made or entered into an agreement with William C. Jones as licensee or otherwise; or whether the said alleged agreement was subject to conditions therein contained; or whether by virute of said agreement said Jones acquired as licensee or otherwise the sole or exclusive or any right to manufacture, sell, lease or deal in in the United States or in any part thereof the said alleged invention hereinbefore referred to and alleged to have been patented by Letters Patent No. 534543, dated February 19, 1895, or whether the said alleged invention formed any part of the subject matter of the said alleged agreement or 45

was within the meaning of the said agreement, or whether the said Jones acquired by virtue of the said alleged agreement any right to assign to others any right acquired by him under the said alleged agreement; or whether by agreement also dated September 2, 1895, or otherwise between said Berliner and said Jones, the said agreement, above noted was confirmed by the said Berliner unto the said Jones, or whether by agreement dated October 4, 1895, or otherwise between the United States Gramophone Company and the said Jones the said agreement or either of the said agreements dated September 2, 1895, was modified in matters relative to the payment of royalties or otherwise, and defendant leaves complainant to make such proof thereof as they may be advised is material or necessary.

Seventh. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether, by a declaration of trust, dated October 15, 1895, or otherwise, said Jones transferred or assigned to the Berliner Gramophone Company or to its successors or assigns, all or any of his right, title or interest as exclusive or sole licensee or otherwise in or to the said alleged invention described and claimed in said Letters Patent No. 534543, or in or to the said Letters Patent No. 534543, or in or to the aforesaid agreements and assignments or any of them, or in or to all or any inventions, letters patent or rights therein or thereunder, and leaves complainants to make such proof thereof as they may be advised is material or necessary.

Eighth. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether by agreement dated September 28, 1901, or otherwise the said Berliner Gramophone Company, did at any time grant or convey, assign or set over unto Eldridge R. Johnson the said exclu-

sive or any license or all or any of its rights therein 49
or thereunder, to manufacture, sell, use or deal in the said alleged invention or inventions; or whether said Berliner Gramophone Company so did with the right to said Johnson to assign the same unto the Victor Talking Machine Company, or whether said Berliner Gramophone Company was then or at any time the owner, sole or other, of said alleged exclusive license to manufacture, sell, lease or deal in said alleged invention and inventions, or any of them, and leaves complainants to make such proof thereof as they may be advised is material or necessary.

Ninth. Defendant denies that it has any knowl- 50
edge or information sufficient to form a belief as to whether said Eldridge R. Johnston ever was the owner, sole or other, of the said alleged license, exclusive or other, to manufacture, sell or deal in the said alleged invention or inventions or any of them, or as to whether said Johnson, by agreement dated October 5, 1901 or otherwise, ever did grant or convey, assign or set over unto the Victor Talking Machine Company the said alleged license, exclusive or other, or all or any of his rights therein or thereunder to manufacture, sell or use or deal in said alleged invention or inventions or any of them, or all or any of his rights and remedies for infringement 51
of the said patent occurring during the alleged period of ownership of said Johnson of said license or rights, exclusive or other, or occuring during any period, and leaves complainants to make such proof thereof as they may be advised is material or necessary.

Tenth. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether the United States Gramophone Company is now or ever was the owner, sole or exclusive or other of the said Letters Patent No. 534543, or

52 whether the Victor Talking Machine Company is now or ever was the licensee sole or exclusive or other under the said Letters Patent No. 534543, for the manufacture or sale of the said alleged invention alleged to be patented in said letters patent throughout the United States or any part hereof; or whether the complainants herein or either of them are now or ever were the owners, sole or exclusive or other, of the title legal or equitable or other, in or to the said Letters Patent No. 534543, or in or to the alleged improvements therein contained, or of all or any rights of action thereto pertaining, and leaves complainants to make such
53 proof thereof as they may be advised is material or necessary.

Eleventh. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether complainants or either of them have expended any sum of money in practising said alleged invention or improvements alleged to be patented in said Letters Patent No. 534543, or in introducing the same into public use, and defendant denies that the same are of any value or practical utility; and denies that any public interest has been manifested therein; and denies that a large demand has been created for apparatus constructed in ac-
54 cordance with or embodying the same; and denies that it has any knowledge or information sufficient to form a belief as to whether complainants are now or ever were ready or able to supply the same, and leaves complainants to make such proof thereof as they may be advised is material or necessary. Defendant denies that the public in any part of the United States has recognized or acquiesced in the claim that the said Berliner was the first or original inventor of the said alleged invention, or that the Patent No. 534543 was good or valid; and denies that the public has acknowledged the claims of

complainants to the rights, exclusive or other, to the 55
said alleged invention under said patent; and denies that but for the alleged infringement or wrongs complained of in the bill of complaint herein, or of alleged recent infringements encouraged by the alleged unlawful acts of this defendant, complainants would be in posession or enjoyment of the said letters patent and alleged invention or of any income derivable therefrom; and denies that it has any knowledge or information sufficient to form a belief as to whether the alleged predecessors in title of complainants or any of them have ever acquiesced in any infringement of their alleged rights in the premises, and leaves complainants to make such 56
proof thereof as they may be advised is material or necessary.

Twelfth. Defendant denies that it has ever had any knowledge or information sufficient to form a belief as to any of the facts set forth in the bill of complaint save as it has been informed thereof by the bill of complaint herein, and denies that it has contrived to injure complainants or either of them, or to deprive them or either of them of any benefit or advantage which might or otherwise would accrue to them or either of them from said devices, methods or things; and denies that it has ever made, sold or used, or is now making, selling or 57
using apparatus or things relative to sound-recording or reproducing having or containing the devices or things patented in said Letters Patent No. 534543, or has ever employed or is now employing any method covered by the said letters patent, or in any respect the same; and denies that the right, exclusive or other, to make, use or vend which to others to use is vested in complainants or in either of them and leaves complainants to make such proof thereof as they may be advised is material or necessary.

58 Thirteenth. Upon information and belief defendant denies that it has ever been notified by complainants or either of them of the alleged rights of complainants or either of them in the premises, or of the fact that it was infringing any letters patent owned by the complainants or either of them, and denies that such ever was the fact; and that it was ever notified to desist from any such infringement; and denies that it has continued or is still continuing to manufacture, sell or use the said alleged infringing devices or things; and denies that it has so done to the damage of complainants or of either of them.

59 Fourteenth. Defendant denies that it has any knowledge or information sufficient to form a belief as to whether complainants have given notice to the public that the said alleged invention is patented; or whether complainants have affixed or caused to be affixed to all apparatus or devices manufactured or sold under their authority the word "Patented" together with the day and year of the grant of the said patent, and this defendant denies that it has had knowledge of such notice and leaves complainants to make such proof thereof as they may be advised is material or necessary; and upon information and belief defend-
60 ant alleges that prior to the beginning of this suit and since the issue of said letters patent, persons acting under the authority of complainants and of their alleged predecessors in title and in interest have, within the United States, made and vended articles in accordance with said patent without affixing thereto the word "Patented" together with the day and year the patent was granted.

Fifteenth. Defendant denies that it has ever made or sold, or intends to continue to make or to sell within the Southern District of New York or

elsewhere within the United States the said pat- 61
ented devices or things having or containing the alleged patented features or any of them, or in any respect the same in construction, operation or effect as in complainants' said letters patent mentioned, or employing any method covered by said letters patent; and denies that it has so done without the license of complainants or of either of them; or without any license whatsoever, or against the will of complainants or either of them; or in violation of the rights of them or of either of them; or to the damage or injury of complainants or of either of them; and denies that it has ever advertised or is now advertising any such infringe- 62
ment and denies that it has ever made any profit by any such unlawful or infringing manufacture and sale; and denies that it has ever been requested by complainants or by either of them to pay over to them or to either of them any such profits; and denies that it has ever refused to pay over to complainants or to either of them any such profits; and denies that it has ever refused to desist from any further infringement of said letters patent; and denies that it has ever done or caused to be done any act, thing or doing in violation of any right or privilege vested in complainants or in either of them by virtue of the said letters patent or 63
contrary to equity or good conscience, or tending to the injury of complainants or of either of them in the premises; and denies that the continuance by defendant of anything heretofore done by defendant will damage or injure complainants or either of them, or depreciate or destroy the value of any franchises which they or either of them are entitled to under the patent aforesaid; or will deprive complainants or either of them of any benefit or advantage for the loss of which there exists no adequate remedy at law. Defendant further answering alleges that at no time and at no place

64 has it in any way infringed upon the said letters patent or any of the claims thereof; or made articles; devices or things in accordance with the alleged invention set forth and claimed in said letters patent, or infringed or trespassed upon any right, privilege, interest or franchise of complainants or of either of them, or of any of their predecessors in title or interest, in the premises, in, to or under said letters patent, and defendant alleges upon information and belief that complainants, well knowing that defendant has in no way infringed upon their rights in the premises, and complainants being competitors of defendant in
65 the talking machine business, brought this suit for business purposes, and principally for the purpose of advertising the same and endeavoring thereby to injure defendant, contrary to justice, equity and good conscience.

Sixteenth. Defendant further answering alleges on information and belief that prior to the alleged invention or discovery by said Emile Berliner of the alleged improvements and inventions described and claimed in said Letters Patent No. 534543, and more than two years prior to the filing of his application therefor, the same and all material and substantial parts thereof had been shown, de-
66 scribed, patented and published in the following patents and publications, to wit:

LETTERS PATENT OF THE UNITED STATES.

Number.	Date.	Patentee.
17146	Apr. 28, 1857	Charles H. Field
32959	July 30, 1861	O. H. Bogardus
52292	Jan. 30, 1866	T. Kennedy
56141	July 3, 1866	Theodore Cooper
72521	Dec. 24, 1867	Ralph S. Mershon
93619	Aug. 10, 1869	L. Hillman

111859	Feb. 14, 1871	Fred. B. Miles	67
115934	June 13, 1871	James M. Connor	
120096	Oct. 17, 1871	Perky	
153084	July 14, 1874	Maurice Joyce	
153212	July 21, 1874	Geo. R. Babbitt	
138006	Apr. 22, 1873	Cooke	
174715	Mar. 14, 1876	Robt. B. Atchison	
183920	Oct. 31, 1876	John C. Guerrant	
191464	May 29, 1877	Loring Pickering	
219939	Sept. 23, 1879	A. Wilford Hall	
222292	Dec. 2, 1879	Thomas L. Luders	
225457	Mar. 16, 1880	Milton Bradley	
231065	Aug. 10, 1880	Robt. M. Lockwood, *et al.*	
232978	Oct. 5, 1880	John W. Kennyon	68
238929	Mar. 15, 1881	Wm. A. Leggo	
250697	Dec. 13, 1881	M. Wheless	
266746	Oct. 31, 1882	Seth E. Beedy	
271903	Feb. 6, 1883	A. S. Nichols	
277349	May 8, 1883	J. Harris Rogers	
279292	June 12, 1883	James H. M. Waldorp	
238665	Aug. 21, 1883	James W. Rogers	
287166	Oct. 23, 1883	Christopher C. Reynolds	
295219	Mar. 18, 1884	John Absterdam	
298030	May 6, 1884	Albert Schmid	
296376	Apr. 8, 1884	Rufus Anderson	69
304640	Sept. 2, 1884	Hackenberg	
305178	Sept. 16, 1884	Geo. M. Guerrant, *et al.*	
336203	Feb. 16, 1886	C. A. Bell	
341212	May 4, 1886	A. G. & C. A. Bell	
341213	May 4, 1886	Bell & Tainter.	
341214	May 4, 1886	Bell & Tainter	
341287	May 4, 1886	Sumner Tainter	
341288	May 4, 1886	S. Tainter	
12192	Jan. 9, 1855	W. J. Casselman	
349664	Sept. 21, 1886	Rodwell	

70	356677	Feb. 1, 1887	C. J. Hohenstein
	362100	May 3, 1887	Maloney
	372786	Nov. 8, 1887	E. Berliner
	364472	June 7, 1887	L. Bock, Jr.
	374133	Nov. 29, 1887	C. S. Tainter
	375579	Dec. 27, 1887	C. S. Tainter
	380535	Apr. 3, 1888	C. S. Tainter
	382790	May 15, 1888	E. Berliner
	383299	May 22, 1888	W. W. Jacques
	385886	July 10, 1888	C. S. Tainter
	385887	July 10, 1888	C. S. Tainter
	392796	Nov. 13, 1888	C. E. Hadley
	392953	Nov. 13, 1888	G. H. Herrington
	393190	Nov. 20, 1888	C. S. Tainter
71	393191	Nov. 20, 1888	C. S. Tainter
	393640	Nov. 27, 1888	E. T. Gilliland
	397856	Feb. 12, 1889	G. H. Herrington
	399264	Mar. 12, 1889	G. H. Herrington
	399265	Mar. 12, 1889	G. H. Herrington
	400629	Apr. 2, 1889	C. Batchelor
	404850	June 11, 1889	G. W. Littlehales
	407127	July 16, 1889	H. F. Searle
	408649	Aug. 6, 1889	D. W. Brown
	408998	Aug. 13, 1889	W. B. Tattershall
	409003	Aug. 13, 1889	G. Bettini
	409004	Aug. 13, 1889	G. Bettini
	409005	Aug. 13, 1889	G. Bettini
72	413282	Oct. 22, 1889	W. W. Jacques
	421450	Feb. 18, 1890	C. S. Tainter
	424914	1890	J. H. White
	424956	Apr. 8, 1890	D. W. Brown
	427279	May 6, 1890	W. Suess
	428273	May 20, 1890	M. L. Deering
	428646	May 27, 1890	C. S. Tainter
	428750	May 27, 1890	L. Glass & W. S. Arnold
	428751	May 27, 1890	L. Glass & W. S. Arnold
	429079	May 27, 1890	O. P. Austin

429827	June 10, 1890	J. H. White	73
430759	June 23, 1890	R. H. St. John	
431883	July 8, 1890	L. F. Douglass	
432462	July 15, 1890	J. H. White	
432886	July 22, 1890	J. P. Magenis	
435055	Aug. 26, 1890	Demming	
436576	Sept. 16, 1890	J. Daniels	
440046	Nov. 4, 1890	J. H. Ling	
440155	Nov. 11, 1890	I. W. Heysinger	
441361	Nov. 25, 1890	Goodwin & Burnett	
441609	Nov. 25, 1890	G. A. Beach	
454947	June 30, 1891	McMahon	
449349	Mar. 31, 1891	P. T. Dodge	
458916	Sept. 1, 1891	Oxley	74
460338	Sept. 29, 1891	I. W. Heysinger	
462687	Nov. 10, 1891	Bruening	
466922	Jan. 12, 1892	J. F. Ott	
467530	Jan. 26, 1892	J. H. White	
472417	Apr. 5, 1892	E. L. Wilson	
474410	May 10, 1892	Rosenthal & Frank	
475490	May 24, 1892	L. F. Douglass	
479431	July 26, 1892	V. Lahola	
486394	Nov. 15, 1892	W. Bruening	
486608	Nov. 22, 1892	W. Bruening	
488379	Dec. 20, 1892	G. Bettini	
488380	Dec. 20, 1892	G. Bettini	
488381	Dec. 20, 1892	G. Bettini	
489666	Jan. 10, 1893	E. L. Wilson	75
493719	Mar. 21, 1893	W. G. Henderson	
499370	June 13, 1893	W. Bruening	
503610	Aug. 22, 1893	J. W. Macintosh	
505910	Oct. 3, 1893	J. W. Wassenich	
506348	Oct. 10, 1893	C. S. Tainter	
510656	Dec. 12, 1893	C. S. Tainter	
515811	Mar. 6, 1894	A. D. Andrews	
518190	Aug. 10, 1894	A. K. Keller	
518191	Aug. 10, 1894	A. K. Keller	
518192	Aug. 10, 1894	A. K. Keller	
520106	May 22, 1894	H. B. Cox	

76	527755	Oct. 16, 1894	T. H. Macdonald
	528273	Oct. 30, 1894	H. D. Lioret
	532851	Jan. 22, 1895	J. E. Wassenich

and in the following letters patent of the United States granted to Thomas A. Edison:

	Number.	Date.
	200521	Feb. 19, 1878
	201760	Mar. 26, 1878
	213554	Mar. 25, 1879
	227679	May 18, 1880
	382414	May 8, 1888
	382416	May 8, 1888
77	382417	May 8, 1888
	382418	May 8, 1888
	382419	May 8, 1888
	382462	May 8, 1888
	386974	July 31, 1888
	393462	Nov. 27, 1888
	393463	Nov. 27, 1888
	393464	Nov. 27, 1888
	393465	Nov. 27, 1888
	393466	Nov. 27, 1888
	393966	Dec. 4, 1888
	393967	Dec. 4, 1888
	393968	Dec. 4, 1888
78	394105	Dec. 4, 1888
	394106	Dec. 4, 1888
	397280	Feb. 5, 1889
	397706	Feb. 12, 1889
	400646	Apr. 2, 1889
	400647	Apr. 2, 1889
	400648	Apr. 2, 1889
	400649	Apr. 2, 1889
	400650	Apr. 2, 1889
	406568	July 9, 1889
	406569	July 9, 1889
	406570	July 9, 1889

406571	July 9, 1889	79
406572	July 9, 1889	
406573	July 9, 1889	
406574	July 9, 1889	
406575	July 9, 1889	
406576	July 9, 1889	
414759	Nov. 12, 1889	
414760	Nov. 12, 1889	
414761	Nov. 12, 1889	
423039	Mar. 11, 1890	
426527	Apr. 29, 1890	
430274	June 17, 1890	
430276	June 17, 1890	
430277	June 17, 1890	
430278	June 17, 1890	80
430570	June 17, 1890	
437423	Sept. 30, 1890	
437424	Sept. 30, 1890	
437425	Sept. 30, 1890	
437426	Sept. 30, 1890	
437427	Sept. 30, 1890	
437429	Sept. 30, 1890	
443507	Dec. 30, 1890	
448780	Mar. 24, 1891	
448781	Mar. 24, 1891	
450740	Apr. 21, 1891	
453741	June 9, 1891	
454941	June 30, 1891	81
454942	June 30, 1891	
456301	July 21, 1891	
456302	July 21, 1891	
457344	Aug. 11, 1891	
460123	Sept. 20, 1891	
465972	Dec. 29, 1891	
484582	Oct. 18, 1892	
484583	Oct. 18, 1892	
484584	Oct. 18, 1892	
484585	Oct. 18, 1892	
488189	Dec. 20, 1892	

82	488190	Dec.	20, 1892
	488191	Dec.	20, 1892
	496191	Apr.	25, 1893
	499879	June	20, 1893
	500280	June	27, 1893
	500281	June	27, 1893
	500282	June	27, 1893
	513095	Jan.	23, 1894
	513097	Jan.	23, 1894
	526147	Sept.	18, 1894

LETTERS PATENT OF GERMANY.

	Emile Berliner	No. 45048	Nov. 8, 1887
83	Emile Berliner	No. 47099	May 16, 1888
	Emile Berliner	No. 53662	Nov. 20, 1889

LETTERS PATENT OF GREAT BRITAIN.

1857	No.	1912	William Mann
1854	No.	1206	Wiley, *et al.*
1860	No.	324	Aime L. E. Brittmayer
1865	No.	682	Lutwyche, *et al.*
1870	No.	325	Henry B. Greenwood
1877	No.	2909	Edison
1878	No.	191	Pritchett
1878	No.	1644	Edison
1878	No.	1988	Cour
84 1878	No.	3804	Bailey
1878	No.	3916	Varey
1878	No.	4074	Arnaud
1878	No.	4951	Wallich
1880	No.	495	Clark
1880	No.	631	Engel
1880	No.	1151	Courtenay
1881	No.	3129	Walker
1882	No.	2259	Barney
1882	No.	291	Hadden
1882	No.	3173	Imray
1886	No.	1947	Taylor

1886	No.	2081	de Combettes	85
1886	No.	2268	Bell	
1886	No.	6027	Johnson	
1886	No.	6042	Johnson	
1886	No.	6047	Johnson	
1886	No.	6062	Johnson	
1886	No.	9453	Wostear	
1886	No.	11499	Lake	
1887	No.	15232	Berliner	
1887	No.	16342	Anders	
1887	No.	16384	Johnson	
1887	No.	17175	Gouraud	
1888	No.	569	Hedick	
1888	No.	616	Brookes	86
1888	No.	1851	Johnson	
1888	No.	1851a	Johnson	
1888	No.	5307	Gouraud	
1888	No.	7204	Berliner	
1888	No.	9762	Adams-Randall	
1888	No.	9981	Johnson	
1888	No.	9996	Adams-Randall	
1888	No.	12593	Gouraud	
1888	No.	12594	Gouraud	
1888	No.	12860	Edmunds	
1888	No.	16212	Gouraud	
1888	No.	16480	Johnson	
1888	No.	16481	Johnson	
1888	No.	17937	Madgen	87
1888	No.	18715	Smith	
1889	No.	1058	Adams-Randall	
1891	No.	15206	Gouraud	
1893	No.	2690	Adams-Randall	
1893	No.	4685	Bott	
1893	No.	8248	Adams-Randall	
1893	No.	23366	Lioret	
1893	No.	24899	Young	
1894	No.	1478	Young	
1894	No.	6482	Moreau & Munier	
1894	No.	7080	Oulton	

88 1894 No. 15737 The Edison-Bell Phonograph Corporation, Ltd., and Wilkinson

1894 No. 16878 Lacey

1894 No. 24588 Robinson

and also in the following patents of Great Britain:

For the year 1889:

Nos. 1058, 5507, 5573, 7625, 7794, 9638, 11866, 12421, 12762, 13841, 15459, 16850, 19153, 19829, 20257, 1868, 13412, 15459.

For the year 1890:

Nos. 4681, 6685, 8197, 11456, 11668, 11669, 15245, 20290, 20306.

89 For the year 1891:

Nos. 5562, 6299, 8792, 8853, 10357, 13480, 15206, 18494, 21250.

For the year 1892:

Nos. 198, 11017, 11990, 15709, 16014.

For the year 1895:

Nos. 8072, 9526.

LETTERS PATENT OF FRANCE.

Thomas A. Edison	121697	Feb. 19, 1878
Patent of addition thereto		Feb. 19, 1878
Thomas A. Edison	129974	Sept. 16, 1878
Charles Cros	124213	July 27, 1878
Patent of addition thereto		Oct. 3, 1878
90 Antonio Vicini	128215	Mar. 17, 1879
Charles Wylier	135688	May 20, 1880
Patent of addition thereto		Mar. 23, 1880
Patent of addition thereto		July 11, 1880
Patent of addition thereto		Sept. 20, 1883
Paul Golonbitisky	145584	Dec. 7, 1881
Patent of addition thereto		Mar. 15, 1882
Patent of addition thereto		Sept. 26, 1883
Morel	146670	Mar. 17, 1882
Morel	146673	Mar. 17, 1882
Claude A. Terrier	156749	Nov. 8, 1883
Emile Berliner	186827	Nov. 8, 1887

Emile Berliner	190602	May 15, 1888	91
Emile Berliner	207090	July 19, 1890	
Werner Suess	205491	May 6, 1890	

LETTERS PATENT OF GERMANY.

Thomas A. Edison	12631	July 12, 1878
Kleist & Co.	11053	Jan. 24, 1879
Thomas A. Edison	14308	Aug. 18, 1891
Thomas A. Edison	12631	Apr. 27, 1881

LETTERS PATENT OF CANADA.

Thomas A. Edison	8026	Oct. 17, 1877
		Issued Oct. 20, 1877.
Thomas A. Edison	9282	Oct. 19, 1878
Emile Berliner, assignee of W. Suess,	41901	Feb. 11, 1893

92

Also the following letters patent granted to Thomas A. Edison in the countries named, to wit:

Belgium—No. 43984, dated Jan. 31, 1878, and No. 45375, dated June 29, 1878.

Italy—No. 422, dated February 8, 1878, and No. ———, dated July 4, 1878.

Austria— , dated Jan. 1, 1879, and , dated Jan. 8, 1879.

Spain— , dated May 6, 1878.

Russia—No. 1161, dated February 15-27, 1882.

Norway— , dated Oct. 8, 1878.

93

Sweden— , dated Mar. 29, 1879.

Denmark—No. 1345, dated October 31, 1878.

Ludia— , deposited Mar. 20, 1879.

New South Wales— , dated Sept. 1, 1878.

Victoria— , dated August 13, 1879, and No. 2549, dated August 15, 1878.

PRINTED PUBLICATIONS.

The Electrical World for August 18, 1888, article on "Improved Gramophone," published at New York, N. Y.

94 Journal of the Franklin Institute, issue of December, 1895, pp. 419-437, printed and published at Philadelphia by the Franklin Institute.

Journal of the Franklin Institute, Vol. 125, p. 425, etc., printed and published in 1888 in Philadelphia by the Franklin Institute.

Journal of the Society of Telegraphic Engineers, Vol. 8, p. 393, etc., printed and published in the year 1879 in London, England.

Engineering, Vol. 27, p. 326, *et seq.*, published at London, Apr. 18, 1879, edited by W. H. Maw and J. Dredge.

Comptes Rendus, Vol. 85, p. 1082, *et seq.*, deposited
95 by Chas. Cros, April 30, 1877, description of phonographs and their operation.

La Nature, issue of May 4, 1879, p. 349, etc.

Journal of the Society of Telegraph Engineers and Electricians, Vol. 8, p. 303, etc., published at London, Apr. 9, 1870.

The Telephone, the Michrophone and the Phonograph, by Count du Moucel, chapter on Phonographs, pp. 235 to 261, etc., published at New York, 1879, by Harper & Bros.

The Speaking Telephone, Talking Phonograph and other novelties, by Geo. B. Prescott, Chap. 10, pp. 292 to 308, etc., published at New York City, 1878.

96 Elementary Treatise on Natural Philosophy, by A. P. Deschanel, part 3, pp. 824, 825, published at London in the year 1872 by Blackie & Son.

Le Rappel, issue of December 11, 1877, published at Paris, France.

Le Rappel, issue of January 15, 1878, published at Paris, France.

The World's Weekly Review of Scientists, Vol. 47, pp. 580, *et seq.*, published by Abbe Moigno, September, December, 1878.

Dana & Silliman's American Journal of Science

and Art, Vol. VIII, pp. 130-131, New Haven, Conn., 1874. 97

Le Telephone, Bibliothique des Merveilles, par le Comte Th. du Moucel, Paris, France, 1880, p. 366.

The Electrical World for November 12, 1887, published at New York, N. Y., article or 'Berliner's Gramophone.'

and were described, shown and patented in various other prior publications and patents, the dates and names of which are at present unknown to defendant; but defendant prays the right to insert by amendment to its answer said publications and patents when ascertained in the course of an investigation as to the prior knowledge and use and patents of said alleged improvements and inventions in which defendant is now earnestly engaged. 98

Seventeenth. Defendant further answering alleges on information and belief that in view of the state of the art at and before the time at which said Emile Berliner is alleged in said bill of complaint to have invented or discovered said alleged improvements and invention, said Emile Berliner was not the original or first inventor or discoverer of any material or substantial part of the alleged improvements and invention described or claimed in said Letters Patent No. 534543 and that said Letters Patent No. 534543 do not and did not describe, specify or claim any subject matter patentable at said time under the statutes of the United States, and that said letters patent are and always have been null and void. 99

Eigtheenth. Defendant further answering, alleges on information and belief that prior to the application in this country for a patent therefor and prior to and after the date of the issue of said Letters Patent No. 534543, said Emile Berliner and

100 his alleged assigns abandoned and had abandoned before the commencement of this suit to the public the alleged improvements and invention claimed to be patented in said Letters Patent No. 534543.

Nineteenth. Defendant further answering alleges on information and belief that prior to the time when the said Emile Berliner is alleged in said bill to have made the alleged improvements and invention described and claimed in said Letters Patent No. 534543, and that more than two years before the application of said Berliner in this country for letters patent aforesaid, said alleged improvements and invention were known and used by others in
101 this country, and were in public use and on sale in this country by divers persons, and among others by the following persons, to wit:

Thomas A. Edison, at Menlo Park, N. J., New York, N. Y., and elsewhere, present residence Llewellyn Park, N. J.

John F. Ott, at Menlo Park, N. J., Orange, N. J., New York, N. Y. and elsewhere present residence Orange, N. J.

Edward H. Johnson, at Menlo Park, N. J., New York, N. Y., and elsewhere, present residence Greenwich, Conn.

Charles Bachelor, at Menlo Park, N. J., New York,
102 N. Y., and elsewhere, present residence New York, N. Y.

John Kruesi, at Menlo Park, N. J., New York, N. Y. and elsewhere, present residence Schenectady, N. Y.

James U. McKenzie, at Menlo Park, N. J., New York, N. Y., and elsewhere, present residence Brooklyn, N. Y.

George H. Herrington, at Wichita, Kan., etc., present residence Wichita, Kan.

Isaac W. Heysinger, at Philiadelphia, Pa., and elsewhere, present residence Philadelphia, Pa.

C. S. Tainter, at Washington, D. C., and elsewhere, present residence Washington, D. C. 103

Maurice Joyce, at Washington, D. C., and elsewhere, present residence Washington D. C.

Christopher C. Reynolds, at Prescott, Ariz., and elsewhere, present residence Prescott, Ariz.

John C. English, at New York, N. Y., and elsewhere, present residence Camden, N. J.

Henry J. Hagen, at Orange, N. J., and elsewhere, present residence Orange, N. J.

Walter Miller, at Orange, N. J., and elsewhere, present residence Orange, N. J.

Chichester A. Bell, at Washington, D. C., and elsewhere, present residence Washington, D. C. 104

Sumner Tainter, at Washington, D. C. and elsewhere, present residence Washington, D. C.

W. W. Jacques at Newton, Mass., and elsewhere, present residence, Newton, Mass.

Charles E. Hadley, at Washington, D. C., and elsewhere, present residence Washington, D. C.

E. T. Gilliland, at New York, N. Y., and elsewhere, deceased.

George W. Littlehales at Pottsville, Pa., present residence Pottsville, Pa.

Gianni Bettini at New York, N. Y., and elsewhere, present residence Paris, France.

Leon F. Douglass, at Chicago, Ill., and elsewhere, present residence Philadelphia, Pa. 105

Cleveland Walcutt, at New York, N. Y., and elsewhere, present residence Paris, France.

Edward F. Leeds, at New York, N. Y., and elsewhere, present residence New York, N. Y.

John H. White, at Washington, D. C., present residence Washington, D. C.

Henri J. Lioret, at New York, N. Y., Washington, D. C., and elsewhere, present residence Paris, France.

Edward H. Amet at Chicago, Ill., Waukegan, Ill.,

106 and elsewhere, present residence Waukegan, Ill.

Alfred C. Clark, at New York, N. Y., Camden, N. J., and elsewhere, present residence Paris, France.

Eldridge R. Johnson at Camden, N. J., New York, N. Y. and elsewhere, present residence Philadelphia, Pa.

Victor H. Emerson, at New York, N. Y., Bridgeport, Conn., and elsewhere, present residence Newark, N. J.

William E. Gilmore at West Orange, N. J., and elsewhere, present residence Orange, N. J.

107 Thomas B. Lambert, at Chicago, Ill., and elsewhere, present residence Chicago Ill.

Henry G. Wolcott, at Fishkill, N. Y., and elsewhere, present residence Fishkill, N. Y.

George H. Stevens, at Toledo, Ohio, and elsewhere, present residence Toledo, Ohio.

A. N. Petit, at Newark, N. J., and elsewhere, present residence London, England.

James K. Reynard, at Newark, N. J., and elsewhere, present residence Newark, N. J.

Marshall C. Lefferts, at New York, N. Y., and elsewhere, present residence New York, N. Y.

Jonas W. Aylsworth, at East Orange, N. J., West Orange, N. J., and elsewhere, present resi-
108 dence East Orange, N. J.

George H. Burt, at New York, N. Y., Camden, N. J., and elsewhere, present residence Boston, Mass.

American Graphophone Co., at Washington, D. C., New York, N. Y., Bridgeport, Conn., and elsewhere, present residence at places aforesaid and, West Va.

Columbia Phonograph Co., at Washington, D. C., and elsewhere, present residence Washington, D. C.

Harry B. Cox, at Hartford, Conn., and elsewhere, last known residence Hartford, Conn. 109

Jos. E. Wassenich, at Chicago, Ill., and elsewhere, last known residence Chicago, Ill.

Werner Suess, at Washington, D. C., and elsewhere, last known residence Washington, D. C.

Edward L. Wilson, at Washington, D. C., and elsewhere, last known residence Washington, D. C.

Chas. W. Jones, at Washington, D. C., Philadelphia, Pa., and elsewhere, last known residence Philadelphia, Pa.

John D. Smoot, at Philadelphia, Pa., and elsewhere, present address Berlin, Germany. 110

Albert T. Armstrong, at New York, N. Y., and elsewhere, deceased.

Frederick Geirling, at Philadelphia, Pa., and elsewhere, present address London, England.

W. Barry Owen, at Philadelphia, Pa., and elsewhere, present address, London, England.

O. P. Ladow, at Philadelphia, Pa., New York, N. Y., and elsewhere, present address, New York, N. Y.

R. A. Glostzer, at Washington, D. C., Philadelphia, Pa., and elsewhere, present address, Berlin, Germany.

William Darby, at Philadelphia, Pa., and elsewhere, present address, Philadelphia, Pa. 111

Werner Suess, at Washington, D. C., Philadelphia, Pa, New York, N. Y., and elsewhere, deceased, last known residence Washington, D. C.

Emile Berliner, at Washington, D. C., Philadelphia, Pa., New York, N. Y., and elsewhere, present residence Washington, D. C.

T. Commerford Martin, at Washington, D. C., Philadelphia, Pa., and New York, N. Y., present residence New York, N. Y.

112 Joseph Wetzler, at Washington, D. C., Philadelphia, Pa., New York, N. Y., and elsewhere, present residence, London, England.

Carl J. Hohenstein, at New York, N. Y., and elsewhere, present residence New York, N. Y.

Chas. R. Cross, at Boston, Mass., and elsewhere, present residence Boston, Mass.

David W. Brown, at Washington, D. C., and elsewhere, present residence Washington, D. C.

W. W. Jacques, at Washington, D. C., New York, N. Y., and elsewhere, present residence Newton, Mass.

Mark E. Deering, at Cleveland, O., and elsewhere,
113 present residence at Cleveland, O.

William McMahon, at Rahway, N. J., and elsewhere, present residence at Rahway, N. J.

Eustace Oxley, at Boston, Mass., and elsewhere, present residence at Boston, Mass.

Wm. Bruening, at East Orange, N. J., and elsewhere, present residence East Orange, N. J.

and by divers other persons in this country, the names and residences of which persons are not at present known to defendant, but defendant prays leave to insert such names and residences, together with the places, in its answer when ascertained in the course of an investigation in which defendant
114 is still earnestly engaged.

Twentieth. That said Berliner having acquiesced in the rejection by the Patent Office of certain claims set forth in his application for said Letters Patent No. 534543, as will fully appear from the file-wrapper and contents of said patent when produced, he and his assigns are estopped from claiming a contruction of the patent and its claims broad enough to include the devices made and sold by defendants.

Twenty-first. For the purpose of deceiving the

public, the description and specification filed by the 115
patentee, said Emile Berliner, in the Patent Office, was made to contain less than the whole truth relative to his said alleged invention and discovery, and more than is necessary to produce the desired result. The said patentee, Emile Berliner, surreptitiously and unjustly obtained the said patent for that which was, in fact, invented by others who were each using reasonable diligence in adapting and perfecting the same, to wit: Werner Suess, and the other persons, who, in Paragraph Nineteenth hereof, are each alleged to have known and used said alleged improvements and invention in this country, and to have had the same in public use 116
and on sale in this country more than two years before the application of said Berliner in this country for said letters patent therefor.

Twenty-second. Defendant further answering alleges that said letters patent are inoperative and invalid by reason of the patentee, said Emile Berliner, claiming as his own invention and discovery more than he had a right to claim as new; and by reason of said patentee claiming as his own the inventions of others set forth and described in the prior patents and publications enumerated in Paragraph Sixteenth hereof.

Twenty-third. Defendant further answering al- 117
leges that before said alleged invention and discovery of said Emile Berliner was patented in United States by said Letters Patent No. 534543, granted February 19, 1895, the same was patented and caused by said Emile Berliner to be patented in foreign countries, by reason whereof under §4887 of the Revised Statutes of the United States, said letters patent of the United States were limited to expire at the same time with said foreign patents and each of them, and with the one having the shortest term; that the foreign patents pre-

118 viously granted and previously patenting said alleged invention and discovery in foreign countries, and limiting the term of said letters patent of the United States as aforesaid, are as follows:

LETTERS PATENT OF GREAT BRITAIN.

No. 15232 of Nov. 8, 1887 to Emile Berliner, for fourteen years from said date, which patent and the term thereof expired on Nov. 8, 1901.

No. 7204 of May 15, 1888, to Emile Berliner, for fourteen years from said date, which patent and the term thereof expired
119 on May 15, 1902.

LETTERS PATENT OF FRANCE.

No. 186827 of Nov. 8, 1887 to Emile Berliner, for fifteen years from said date, which patent and the term thereof expired on Nov. 8, 1902.

No. 190,602 of May 15, 1888, to Emile Berliner, for fifteen years from said date, which patent and the term thereof expired on May 15, 1903.

No. 207090 of July 19, 1890, to Emile Berliner, for
120 fifteen years from said date, which patent and the term thereof expired July 19, 1905.

LETTERS PATENT OF GERMANY.

No. 45048 of Nov. 8, 1887, to Emile Berliner, for fifteen years from said date, which patent and the term thereof expired on Nov. 8, 1902.

No. 47099 of May 16, 1888, to Emile Berliner, limited to expire and it and its term did so expire, on Nov. 7, 1902, with said patent No.45048 being an addition thereto. 121

No. 53622 of Nov. 20, 1889, to Emile Berliner, limited to expire and it and its term did so expire, on Nov. 7, 1902, with said patent No. 45048, being a second patent of an addition thereto.

LETTERS PATENT OF CANADA.

No. 41901 of Feb. 11, 1893 to Emile Berliner, for the term of six years from said date, which patent and the term thereof expired on Feb. 11, 1899. 122

Wherefore defendant alleges that said Letters Patent of the United States have long since expired and are not now in force or effect, and had expired before the commencement of this suit in equity; by reason whereof, neither complainants nor either of them are entitled or have ever been entitled to an injunction or any other relief against this defendant, and by reason whereof this Court of equity has not, and never has had jurisdiction of this suit, and by reason whereof complainant had at the time of the commencement of this suit an adequate remedy at law. 123

Defendant further answering alleges that said Emile Berliner before fil[illegible] an application in the United States for said Letters Patent No. 534543, filed an application in Canada on May 5, 1891, as assignee of Werner Suess for Letters Patent of Canada, for the invention described and claimed in said Letters Patent No. 534543, and especially in claims 5 and 35 thereof, and in his petition for said

124 Letters Patent of Canada, said Emile Berliner declared that Werner Suess had invented said alleged new and useful improvements in gramophones, and that the same were not known or used by others before the invention thereof by said Werner Suess; that thereafter and upon said application and petition of said Emile Berliner, Letters Patent of Canada, No. 41901, of February 11, 1893, were issued to said Emile Berliner, assignee of said Werner Suess for the term of six years for said alleged new and useful improvements in gramophones described and claimed in said Letters Patent No. 534543; that said Canadian Letters Pat-
125 ent No. 41901 expired on February 11, 1899, with the expiration of the term of six years for which the same had been granted. Wherefore the defendant alleges that said Emile Berliner was not the inventor of any invention described or claimed in said Letters Patent No. 534543, and especially in claims 5 and 35 thereof, and that said Letters Patent No. 534543, under §4887 of the Revised Statutes of the United States could not and did not continue in force subsequent to the expiration of said Canadian Patent on February 11, 1899, as aforesaid, and have always been null and void.

Twenty-fourth. Defendant further answering
126 prays the same benefit of the facts and things herein set forth as if for the reason thereof it had demurred to the said bill of complaint where a demurrer would have been proper, and the same benefit thereof as if it had specially pleaded to said bill where a plea would have been proper.

Twenty-fifth. Defendant upon information and belief denies every allegation in said bill contained not herein already admitted or denied.

All of which statements and defences this defendant is ready to aver, maintain and prove as this

Honorable Court shall direct, and prays hence to be dismissed with its reasonable costs in this behalf most wrongfully sustained. 127

LEEDS & CATLIN COMPANY,

(Seal: Leeds & Catlin Company, New York. Incorporated 1899.) by E. F. Leeds, Pres.

Louis Hicks,
Solicitor and Counsel for Defendant.

State of New York, } ss.:
County of New York, }

Edward F. Leeds, being duly sworn, says that the defendant herein, Leeds & Catlin Company is a corporation organized and existing under and by virtue of the Laws of the State of New York, and that he is president thereof, and therefore makes this verification; that he has read the foregoing answer and knows the contents thereof, and that the same is true of his own knowledge, except as to the matters therein stated to be alleged upon information and belief, and that as to those matters he believes it to be true. 128

E. F. LEEDS.

Subscribed and sworn to before me this 20th day of December, 1905 }

T. P. Dalton, 129
[NOTARY'S SEAL] Notary Public,
Kings Co.

Cert. filed in New York Co.
(Answer filed Dec. 21, 1905.)

130 IN THE CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on Berliner Gramophone Patent No. 534543.

VICTOR TALKING MACHINE COMPANY, and the United States Gramophone Company,
131 Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

The replication of the Victor Talking Machine Company and the United States Gramophone Company, complainants, to the answer of Respondent, Leeds & Catlin Company.

These repliants, saving and reserving unto themselves all and all manner of advantage and exception to the manifold insufficiencies of said answer
132 of the respondent, Leeds & Catlin Company, for replication thereunto say, that they will aver and prove their said bill to be true, certain and sufficient in law to be answered unto, and that the said answer of the respondent, Leeds & Catlin Company, is uncertain, untrue and insufficient to be replied unto by these repliants; without this that any other matter or thing whatsoever in the said answer contained, material or effectual in the law to be replied unto, confessed and avoided, traversed or

denied, is true; all of which matters and things 133
these repliants are and will be ready to aver and prove as this Honorable Court shall direct; and humbly pray, as in and by their said bill they have already prayed.

Sgd. HORACE PETTIT.
Of Counsel for Complainants.

February 3d, 1906.
Stimson & Williams,
Solicitors for Complainants.
[Replication filed February 7, 1906.]

Order to Show Cause.

CIRCUIT COURT OF THE UNITED STATES, 134

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on Berliner Gramophone Patent No. 534543.

VICTOR TALKING MACHINE COMPANY, and the United States Gramophone Company,
Complainants,

vs. 135

LEEDS & CATLIN COMPANY,
Defendant.

And now, to wit: this 24th day of March, A. D., 1906, the complainants having filed their bill of complaint, upon the application of complainants' counsel, and upon the affidavits of Harry Cobb Kennedy, verified March 23, 1906, Albert C. Middleton, verified March 23, 1906, and John A. Fagan,

136 verified March 24, 1906, and upon the exhibits filed in connection therewith and in support thereof, it is this day

Ordered that a preliminary injunction, in conformity with the prayer in said bill of complaint, issue out of and under the seal of this Court on the sixth day of April, A. D. 1906, unless the defendant shall show cause before me, on the 6th day of April, A. D. 1906, at ten o'clock in the forenoon, or as soon thereafter as counsel can be heard, in the Court rooms of the United States Circuit Court for the Southern District of New York, in the Federal Building, in the Bor-
137 ough of Manhattan, City and State of New York, why said preliminary injunction should not be issued against the defendants in the above entitled cause, as prayed in said bill of complaint; and it is further

Ordered, that a copy of this order and affidavits referred to herein be served upon the defendant; that the answering affidavits, if any, to be used by the defendant in opposition to the granting of said preliminary injunction at the hearing on this order to show cause, be filed in the office of the Clerk of this Court, on or before five o'clock on the afternoon of March 31st, 1906; and that the affidavits, if any, of the complainants in rebuttal, to be used
138 by the complainants at the hearing on this order to show cause, be filed in the office of the Clerk of this Court before five o'clock on the afternoon of April 5th, 1906.

(Sgd.) E. HENRY LACOMBE,
U. S. C. J.

Affidavit of John A. Fagan Sur-Motion for Preliminary Injunction. 139

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on Berliner Gramophone Patent, No. 534543.

VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company, Complainants, 140

vs.

LEEDS & CATLIN COMPANY, Defendant.

City of New York, } ss.:
County of Kings, }

John A. Fagan, New York City, State of New York, being duly sworn according to law, deposes and says as follows: 141

I reside at 327 Second Street, in the Borough of Brooklyn, in the City of New York, State of New York. In the Fall of 1903, I was in the employ of the Victor Distributing & Export Company, of New York, N. Y., and while in their employ I called at the place of business of the Leeds & Catlin Com-

142 pany, of No. 53 East 11th Street, in the Borough of Manhattan, City and State of New York, for the purpose of buying from said Leeds & Catlin Company a talking machine and sound records. The date upon which I called at the said place of business of the Leeds & Catlin Company was November 30, 1903, and at that time I purchased from the said Company a flat disc talking machine and five flat disc sound records for said talking machine. The said talking machine which I purchased was known as the "Ohio Talk-o-Phone" and on one side of the cabinet of said machine the following words appeared, namely, "Ohio Talk-o-Phone, Toledo,
143 Ohio, U. S. A.". This talking machine which I purchased at that time consisted of an oak cabinet with a hinged cover, which cover carried a spring motor on the inside and a turntable on the outside mounted upon the spindle of said motor. A swinging arm is pivoted to its outer end by a universal joint to the outer end of a bracket ridgidly mounted upon said cabinet, this swinging arm being of metal, and carrying at its inner end a sound box, which sound box communicates with an amplifying horn also carried by said swinging arm, but removable therefrom.

The flat disc sound records which I purchased at that time were made of black hard material,
144 having in their faces spiral grooves of even depth, with lateral undulations in the sides thereof made by the recorded sounds. These flat disc records have a gold seal impressed centrally in their front faces, upon which appears the words "Leeds Records," together with the data for identifying the number and name of the selection appearing upon the record. These records are adapted to be

used only in connection with the talking machines 145
of the flat disk record type, such as the one I purchased, as above stated, and such talking machine is only adapted for use in connection with the flat disc sound record, like the one I purchased. And said machines and records are sold for use in connection with each other, and were so sold to me by the said Leeds & Catlin Company on November 30, 1903, as before stated. The machine, as sold to me, consisted of the said cabinet, as I have described, and the swinging arm, the sound box, an amplifying horn and a crank for winding up the motor, which parts accompany this affidavit, and are marked "Complainants' Exhibit, Defendant's Machine."

The flat disc sound records which I purchased 146
from the Leeds & Catlin Company on the 30th of November, 1903, as before said, are five in number, and are marked "Complainants' Exhibit, Defendants' Sound Records."

For the said talking machine I paid the Leeds & Catlin Company on November 30, 1903, the sum of $31.50, and for the five disc records I paid the said Leeds & Catlin Company the sum of $2.45, and received from the said Leeds & Catlin Company a bill for these goods, containing the following items, namely:

To one Ohio Talking Mach.	31.50		147
to 5 Leeds Disc Rds.	2.45	$33.95	

Reed Paymt
Leeds & Catlin Co.

145a The said bill is attached hereto and marked "Complainants' Exhibit, Leeds & Catlin Bill."

Signed John A. Fagan.

Subscribed and sworn to before me this 24th day of March, 1906.

Signed Otto F. Peterson,
Notary Public,
Kings Co., N. Y.

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

146a

In Equity, No. 8797.

Suit on Berliner Gramophone Patent No. 534543.

VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
147a Defendant.

"Complainants' Exhibit, Leeds & Catlin Co. Bill."
(Signed) Otto F. Peterson,
Kings Co., N. Y.

Complainants' Exhibit, Leeds & Catlin Co. Bill. 145b

No claims allowed unless made immediately on receipt of goods. Claims for Breakage, Loss or Detention to be made on the Transportation Companies.

Our responsibility ceases when we obtain a receipt for goods shipped in good order.

Leeds & Catlin Co.

Making the Loudest and Clearest Phonograph Records and Edison Phonograph Supplies at 53 East Eleventh Street.

Terms C. O. D.

Conveyance 146b

New York, Nov. 30, 03

Sold To J. Fagan

To one Ohio Talking Mach.	31.50	
To 5 Leeds Disc Rds	2.45	
		$33.95

Reed Paymt 147b

Leeds & Catlin Co.

148 **Affidavit of Albert C. Middleton sur Motion for Preliminary Injunction.**

CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on the Berliner Gramophone Patent, No. 534543.

149 VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

Commonwealth of Pennsylvania, } ss.:
City and County of Philadelphia, }

150 Albert C. Middleton, being duly affirmed, deposes and says as follows:

I am Secretary of the Victor Talking Machine Company, a corporation organized and existing under the laws of the State of New Jersey, and having its special place of business in the City of Camden, in said State, one of the complainants herein, and have been since its organization in October, 1901.

The said Victor Talking Machine Company manufactures disc talking machines, and records therefor, under United States Letters Patent to Emile Berliner, No. 534543, dated February 19, 1895, for

a gramophone, which patent I am informed and be- 151
lieve, as to Claims 5 and 35, has been held valid by the Circuit Court of Appeals for the Southern District of New York in a certain suit by the Victor Talking Machine Company and the United States Gramophone Company against the American Graphophone Company, the opinion of said Circuit Court of Appeals for the Second Circuit having been entered on or about March 9, 1906.

The Victor Talking Machine Company manufactures and sells various styles of talking machines and sound records constructed in accordance with the invention of said patent, and accompanying this affidavit is one style of talking machine and a disc
sound record so manufactured and sold by said 152
Victor Talking Machine Company, and which are marked "Complainants' Exhibit, Complainants' Machine," and "Complainants' Exhibit, Complainants' Sound Record." Said complainants' machine is the style of machine known as a flat disc record talking machine, which comprises a cabinet containing a motor and upright spindle which projects centrally through the top of the cabinet and carries a turn-table. A swinging arm is supported at its outer end by a laterally projecting rigid arm mounted upon the cabinet, the outer ends of the swinging arm and the rigid arm being connected by the universal joint to allow a free vertical and 153
horizontal movement of the arm. The free end of the swinging arm is provided with means for carrying the sound box, which latter connects with an amplifying horn also carried by said swinging arm. Complainants' Exhibit, Complainants' Sound Record, is a flat disc of indestructible material, in the face of which is a spiral groove of even depth having lateral undulations representing the sounds to be reproduced. The stylus of the sound box engages the record groove of complainants' sound record, and when the latter is rotated with the turn-

154 table the stylus is laterally vibrated to set up vibrations in the sound box diaphragm corresponding to those recorded in the sound record groove, and at the same time said spiral record groove propels the stylus and reproducing apparatus automatically across the surface of the sound record independent of any other means.

The Victor Talking Machine Company has manufactured and sold this style of talking machine and sound record ever since its incorporation in October, 1901.

The said Complainants' Exhibit, Complainants' Machine, is manufactured for use only in connection with flat disc records similar to Complainants'
155 Exhibit, Complainants' Sound Record, and the said sound records are manufactured for use only in connection with machines similar to said complainants' machine.

I have also examined Complainants' Exhibit, Defendant's Machine, and Complainants' Exhibit, Defendant's Record, and find that they not only embody the same structure, but, except as to non-essential and immaterial changes not effecting the general construction or operation of the device, they are duplicates of complainants' machine and complainants' record. It would be useless for me to describe defendant's machine and defendant's
156 sound record in detail, as it would simply be a repetition of the description which I have heretofore given of complainants' machine and complainants' sound record, and, furthermore, the operation is the same, and both in complainants' and defendant's machines and records the machine is only capable of use in connection with a record of this description, and the record is only capable of use in connection with a machine of this description, and when in use and operation the spiral groove of even depth with lateral undulations in the sides of said groove not only impart to the

stylus which travels in said groove lateral undulations, which lateral undulations are imparted to the diaphragm to reproduce the recorded sounds, but said spiral groove automatically propels the stylus and the reproducing apparatus across the face of the record from the beginning to the termination of the composition or other matter recorded upon said record. 157

In other words, there is absolutely no essential difference in the construction of complainants' and defendant's machines and sound records, nor in their operations.

(Signed) ALBERT C. MIDDLETON.

Affirmed and subscribed to before me this twenty-third day of March, A. D. 1906. 158

(Sgd.) Alexander Park,
[SEAL.] Notary Public.
Commission expires Feb. 6, 1909,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

159

160 **Affidavit of Harry Cobb Kennedy Sur Motion for Preliminary Injunction.**

CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

In Equity, No. 8797.

Suit on the Berliner Gramophone Patent, No. 534543.

VICTOR TALKING MACHINE COMPANY and the United States Gramophone Company,
161 Complainants.

vs.

LEEDS & CATLIN COMPANY,
Defendant.

Commonwealth of Pennsylvania, } ss.:
City and County of Philadelphia, }

Harry Cobb Kennedy, being duly sworn according
162 to law, deposes and says, as follows:

I am a member of the Bar, and an assistant to Horace Pettit, Esquire, of Counsel for the complainants in the above entitled cause, and am familiar with this litigation and the pleadings herein. The bill of complaint herein was filed October 1st, 1904, and on November 7, 1904, the defendant appeared by counsel. On December 19, 1904, the defendant demurred to the bill of complaint, which demurrer was duly set down for argument on December 2, 1904, and a note of issue duly filed to bring said demurrer on for argument at the earli-

est term of Court after which it had been set down 163
for argument. The cause was on the calendar for the April, 1905, Term of this Court, but the Court adjourned before it was reached for argument, and it went over to the October Term, 1905. On October 23, 1905, over a year after the bill of complaint had been filed, the demurrer was argued, and on October 31, 1905, an opinion was filed by Judge Holt overruling the demurrers, and on November 22, 1905, on order was signed and filed in conformity with said opinion, and defendant's answer was filed on December 21, 1905, the replication being filed on Februray 7, 1906.

This suit is for infringement of the Berliner 164
Patent No. 534543, for a gramophone, a copy of which is hereto annexed and marked "Complainants' Exhibit, Berliner Patent in Suit," and when the present suit was brought to issue on February 7, 1906, another suit for the infringement of this patent has been argued on appeal before the Circuit Court of Appeals for this Circuit, and was then awaiting the decision of said Court. This other suit, to which I refer was entitled the Victor Talking Machine Company and United States Gramophone Company vs. The American Graphophone Company, instituted in the United States Circuit Court for the Southern District of New York, in
Equity No. 8627. This suit against the American 165
Graphophone Company was vigorously defended and came on to final argument and full pleadings and proofs before Judge Hazel on June 5 and 6, 1905, and was taken under advisement by the Court, and on September 28, 1905, an opinion was filed by Judge Hazel holding Claims 5 and 35 of said Patent, No. 534543, in suit, valid and infringed by defendant's talking machine, also ordering an injunction, with costs, to complainants. A copy of said opinion by Judge Hazel is attached hereto

166 and marked "Complainants' Exhibit, Judge Hazel's Opinion." An application for re-hearing was argued on October 27, 1905, before Judge Hazel, and was refused, and on the same day a final decree was entered for the complainants, together with an order suspending the operation of the decree until adjudication by the Court of Appeals. Thereafter, an appeal was duly prosecuted and was argued on its merits before the United States Circuit Court of Appeals for the Second Circuit on January 17 and 18, 1906, and on March 9, 1906, the Circuit Court of Appeals, *per curiam*, affirmed the opinion of the lower Court sustaining the validity of Claims 5 and 35 and holding that
167 these claims were infringed by the defendant's structure. A copy of said *per curiam* of the Court of Appeals is attached hereto and marked "Complainants' Exhibit, Court of Appeals *Per Curiam*." When the present suit of the Victor Talking Machine Company, et al, vs. The Talk-o-Phone Company was brought to issue on February 7, 1906, the said case against the American Graphophone Company had been taken under advisement by the Court of Appeals and had not been decided.

The patent in suit is for a gramophone or talking machine, that is to say, a machine for reproducing recorded sounds. The sounds to
168 be reproduced are recorded in a flat disc sound record by means of spiral grooves of even depth containing lateral undulations conforming to the sound waves produced by the sounds to be recorded. This flat disc sound record is carried by a turn-table rotated by means of a suitable motor. To reproduce the sounds, a sound box or reproducing apparatus is employed. A swinging arm, suitably supported at one end, carries this sound box at its other end, the said sound box communicating with a suitable amplifying horn carried also by said swinging arm. The sound box

contains a diaphragm which is set in vibration by a 169
stylus suitably connected therewith, which stylus enters the record groove and is laterally vibrated thereby. These lateral vibrations being reproduced in the diaphragm which sets up vibration within the sound box and amplfying horn similar to these recorded on the flat disc sound records, and also similar to the sound waves by which the record groove was made in the flat disc sound record.

Claims 5 and 35 of the patent in suit read, as follows:

> "5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same 170
> along the record by and in accordance with the said record, substantially as described."
>
> "35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described."

The United States Circuit Court of Appeals, in affirming the decree of the Court below in the *per curiam* filed March 9, 1906, stated as follows:

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> "In affirming this decree we do not find it necessary to add anything to be careful and exhaustive discussion of the issues which will be found in Judge Hazel's opinion, with one single exception."

This single exception is, that without discussing the question raised in the Court below disposing of the defence of prior public use, and without expressing any definite opinion either way as to the manner in which it was decided by the Court below, the Court of Appeals held that on another ground,

172 namely that of continuing applications, his defence of prior public use would not avail the defendant, so that the manner in which Claim 5 and 35 were construed by the Court below thereby becomes the opinion of the Court of Appeals.

Prior to the invention of the patent in suit the reproducing styles of same reproducing machines was fed across the surface of the round record by a feed screw, or other means independent of the record itself, and the main distinction of the invention of the patent suit over the prior art is in the manner of the propelling of the stylus across the record, which is not accomplished by an auxiliary feed
173 screw, but is due to the operating engagement of the stylus point with the record groove itself, independently of other means, or as Judge Hazel states in his opinion sustaining the validity and holding infringement of Claims 5 and 35:

> "Complainants contend, and the proofs show, that the stylus attached to the diaphragm is arranged so as to permit the same to vibrate laterally, and that owing to lateral undulations in the walls of the record grove, a desirable swaying motion is imparted to the reproducer diaphragm. Concededly, the lateral undulations in the record
> 174 automatically guide or propel the stylus and diaphragm in its course over the disc from the outer circumference toward the center, and the stylus travels in an apparently direct radial path while at the same instant of time it is pulsated or incited by the sound waves. The principle of operation in the Berliner machine is thought to be essentially different from that of the machine of Bell & Tainter. In the latter, an auxiliary joint or feed screw was necessary, as already stated, to effectuate the required passage of

the record over the joint of the stylus, or to 175
cause the stylus and reproducer diaphragm to travel across the surface of the record. In complainant's patent, on the other hand, it is shown that the lateral vibrations of the stylus point and the propelling of the same over the surface of the record without mechanical assistance and through the means of the groove alone was the primary object of the inventor." * * * "but from what has already been said regarding the Bell & Tainter Patent, it is manifest that the principle of Berliner's invention rests upon the practicability of propelling the stylus in the 176
groove across the surface of the record without a feed screw or other mechanism. By such adaptation to what is known in the art as a zig-zag record (Complainant's record) certain imperfections in the talking machines were overcome, and sound, when reproduced, was rendered intelligible. There was, I think, patentable novelty in the method which accomplished the results stated." * * * The essence of such claims would seem to include a sound record which, when in juxtaposition with a diaphragm and stylus propelled in the manner described, is thereby enabled to 177
successfully accomplish the primal object and purpose of the invention."

In the said suit against the American Graphophone Company so decided by the Court of Appeals as aforesaid, I have examined the exhibits of complainants' and defendant's machine and records, and am conversant with the same, and except for certain specific details of structure, non-essential changes of material and very slight changes in ornamentation or style, Complainants' Exhibit, De-

178 fendant's Machine, is a practical duplicate of Complainants' Exhibit, Complainants' Machine, as manufactured under the patent in suit. And the structure embodied in Complainants' Exhibit, Defendant's Sound Record, as compared with Complainants' Exhibit, Complainants' Sound Record, is also the same flat disc sound records made of hard, indestructible material, in the faces of which are impressed a spiral record groove of even depth with lateral undulations, which record groove serve the two-fold purpose of vibrating the stylus to produce the necessary vibrations in the diaphragm of the sound box, and also to automatically propel the stylus in the groove across the surface of the record
179 without a feed screw or other mechanism independent of the record itself.

I have also examined the exhibits introduced in this cause against The Talk-o-Phone Company, namely, Complainants' Exhibit, Complainants' Machine; Complainants' Exhibit, Complainants' Sound Record; Complainants' Exhibit, Defendant's Machine, and Complainants' Exhibit, Defendant's Sound Record, and I find that Complainants' Exhibits, Complainants' Machine and Sound Record are the same as the said Complainants' Exhibits, Complainants' Machine and Sound Record introduced in evidence in said suit against the American
180 Graphophone Company, so decided by the Court of Appeals. Comparing the exhibits in this present suit, I find that Complainants' Exhibits, Defendant's Machine, is essentially the same as Complainants' Exhibit, Complainants' Machine, introduced in evidence in this suit, and also is the same as Complainants' Exhibit, Defendant's Machine, introduced in evidence in said suit against the American Graphophone Company. That is to say, in all of these exhibits, there is a cabinet or casing containing a spring motor, the upright spindle of which projects centrally through the top of the

cabinet and carries a turn-table. From one side of 181
the cabinet there is a projecting arm. In a bearing at the outer end of this arm is mounted a swinging arm capable of swinging horizontally and vertically on a universal joint, while the inner and free end of this swinging arm carries a sound box, with which is connected an amplifying horn supported and carried also by said swinging arm. Complainants' Exhibit, Defendant's Sound Record, is the same structurally as Complainants' Exhibit, Complainants' Sound Record, offered in evidence in this suit, and likewise the same as the Complainants' and Defendant's Sound Record before the Court in said suit against the American Graphophone Company so decided by the Circuit Court of Appeals, 182
that is to say, it is a flat disc sound record of hard material having in its face a spiral groove of even depth with the lateral undulations. This Defendant's Sound Record in the present suit is adapted, as in the other devices, to be carried and rotated by the turn-table, and the stylus of the sound box engaging the spiral groove therein causes lateral vibrations in the diaphragm and these vibrations of the diaphragm set up the sound waves in the sound box and amplifying horn while at the same time the sound box and stylus are automatically propelled across the surface of the record by reason of the record groove itself, and independently of 183
any other means or mechanism.

As there is absolutely no difference between the construction of defendant's machine and sound record and the invention set forth and claimed in Claims 5 and 35 of the patent in suit, as far as the principle of Berliner's invention as to vibrating the diaphragm and propelling the stylus and the sound reproducer by and in accordance with the groove of the sound record across the surface of the record, and without a feed screw or other mechanism, and in view of the fact that defendant's machine and

184 sound record offered in evidence in this suit do vibrate the stylus and propel it and the sound reproducer across the surface of the record in the patent in suit and as it is done in Complainants' Exhibit, Complainants' Machine, and Complainants' Sound Record in said suit against the American Graphophone Company, so decided by the Court of Appeals, in my opinion, the said Complainants' Exhibit, Defendant's Machine and Sound Record, in this suit contain all the means and instrumentalities called for by Claims 5 and 35 of the patent in suit and constitute an infringement of these claims.

The Complainants' Exhibit, Defendant's Machine and Defendant's Sound Record, are manufac-
185 tured for use in connection with each other, and are so used and in my opinion are incapable of use in any other connection in a practical manner.

(Sgd.) HARRY COBB KENNEDY.

Sworn and subscribed to before me this 23d day of March, 1906.

(Sgd.) Alexander Park,
Notary Public,
Commission expires 2/6/09,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

[SEAL.]

[Note: For copy of Complainants' Exhibit, Berliner Patent in suit, No. 534543, see *infra*, p. 452.]
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(Copy of Decision of Judge Hazel of September 28, 1905.) 187

(Sgd.) Alexander Park,
[SEAL.] Notary Public,
Commission expires 2/6/09,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

UNITED STATES CIRCUIT COURT,
SOUTHERN DISTRICT OF NEW YORK.

In Equity.

188

VICTOR TALKING MACHINE COMPANY and United States Gramophone Company,
Complainants,

vs.

AMERICAN GRAPHOPHONE COMPANY,
Defendant.

189

HORACE PETTIT, of Counsel for Complainants.
ELISHA K. CAMP, for Defendant.
PHILIP MAURO, C. A. L. MASSIE, of Counsel.

HAZEL, J.:

The bill is in equity and relates to the infringement of Letters Patent No. 534543, issued February 19, 1895, to Emile Berliner, assignor to complain-

190 ants, on application filed March 30, 1892, for improvements in a talking machine commonly known as the gramophone. The apparatus to which the improvements relate, is constructed to record and reproduce vocal sounds. The patent has 35 claims, of which Claim 5, for the process, and 35, for construction of the recording and reproducing apparatus, alone, are involved. Such claims read as follows:

> 5. "The method of reproducing sounds from a record of the same, which consists in vibrating a stylus and propelling the same along the record by and in accordance with
191 the said record, substantially as described.
>
> 35. "In a sound reproducing apparatus, consisting of a travelling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record, and free to be vibrated and propelled by the same, substantially as described."

At the date of the invention in suit it was not new to record sound and articulated words and reproduce the same by suitable mechanical agencies. Numerous defences are interposed in the answer, viz.: anticipation; prior use; abandonment and non-
192 patentability. The objection is also urged that the Court is without judisdiction, on the ground that complainants, before the suit was instituted, agreed in writing to release the defendant from the payment of damages and to grant to it a license to use, sell and manufacture the patented machine provided the patent in suit was held valid by the Court. Such objection, however, which is erroneously sought to be sustained upon the authority of Root vs. Railroad Co., 105 U. S., 180, is without merit. The principle is unassailable that where mere damages are sought to be recovered in an ac-

tion for infringement of a patent, a court of equity will not interfere. But where the bill, alleging infringement of an unexpired patent, demands damages and permanent injunction, equitable relief in a proper case will not be refused. A prior agreement by which the interested parties mutually agree upon terms of settlement on condition that the patent in controversy is sustained by the Court, cannot upon principle and authority deprive a court of its inherent power and jurisdiction (McMillan vs. St. Louis & Miss. Valley Transp. Co., 18 Fed., 260; Guaranty Co. vs. Green Cove Rd. Co., 129 U. S., 137; to the same effect see Doyle vs. Continental Ins. Co., 94 U. S., 535; Insurance Co. vs. Morse, 20 Wall, 445). It is insisted on the part of the defendant that the evidence conclusively shows that there was a public use of the invention for more than two years prior to the application for the patent; that the inventor abandoned his right to the claims in suit by a postponement of them, and that in an earlier application for a patent, he described such claims in his specifications without, however, claiming them. The complainants contend that the alleged prior public use was for the purpose of experiment, and that there was no abandonment in fact. To properly understand the defences, it is necessary to consider the state of the art and to briefly indicate the principles of the various talking machines commonly known and mentioned in the record. The references relied upon to anticipate the involved claims are, first, the Franklin Institute lecture by the patentee, on May 16, 1888; second, a publication by him in the Electrical World, on November 12, 1887; and, third, the patents to Bell & Tainter, No. 341214, dated May 4, 1886, and to W. Suess, assignor to Emile Berliner, No. 427279, issued May 6, 1890. In the British Patent to Edison, No. 1644, dated April 24, 1878, for recording and reproducing vocal sounds, the air vibrations were recorded by a

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196 system of indentations upon a pliable or yielding material, as, for instance, a thin sheet of metal or tin foil. The foil was ordinarily placed over a grooved substance and received impressions of the voice through the instrumentality of a moveable, inelastic diaphragm, having at its end an indenting point or stylus. In order to effectuate the reproduction of sound vibrations, the point of the stylus was essentially kept in constant contact with the revolving record, cylinder or disc. This was accomplished by a mechanical device which propelled the stylus across the surface of the record. In the graphophone patent, issued to Bell & Tainter, the record was engraved or cut in wax-like or
197 amorphous material. The form of cutting or engraving was in a spiral groove of varying depth, the side of the walls sloping toward the bottom. The stylus, which curved in a downward direction, was kept in the groove by gravity and as the record rotated it was vibrated vertically "in the direction of its length." It is shown by the evidence that the graphophone in one form, which is illustrated in the drawings attached to the patent, required mechanical means to propel the record past the reproducer diaphragm and stationary stylus. In another form a moveable stylus attached to the diaphragm was propelled by an auxiliary device across the record
198 so as to retain the stylus point in constant contact with the vertical undulations. These different forms of talking machines are disclosed by the patents or prior date. The common form of style being adapted to record and reproduce vocal sounds at the instance of the user, and the other to merely reproduce sound vibrations as had previously been recorded in accordance with the process of the patentee.

In the patent to Emile Berliner, No. 564586, issued on July 28, 1896, application filed November 7, 1887, the process of recording and reproducing

sound vibrations differs essentially from the method 199
used in the phonograph and the graphophone. The specification described a process by which the sounds were inscribed upon a layer of non-resisting material; which was afterwards copied in a non-yielding material, from which the sounds were reproduced. The specification says:

> "The original record, as well as the copy of the same, is thus obtained as an undulatory line of even depth, as distinguished from the line of varying depth obtained by the ordinary phonograph and graphophone."

It is not disputed that such mode or process was 200
a new and meritorious invention and that it was not merely a patent for the functional effect of the machine in connection with which it was used. The earlier specification does not claim the method nor the details of construction of the claims in controversy; hence it is contended by the defendant, as will presently appear, that there was a surrender or waiver thereof. In the patent in suit two features of the invention are mentioned, one concerning the process or mode of recording sound upon a record, the other as to the construction of the apparatus. Complainants contend, and the proofs show, that the stylus attached to the diaphragm is arranged so as to permit the same to vibrate lat- 201
erally, and that owing to lateral undulations in the walls of the record groove, a desirable swaying motion is imparted to the reproducer diaphragm. Concededly, the lateral undulations in the record automatically guide or propel the stylus and diaphragm in its course over the disc from the outer circumference toward the center, and the stylus travels in an apparently direct radial path while at the same instant of time it is pulsated or incited by the sound waves. The principle of operation in the Berliner machine is thought to be essentially different from

202 that of the machine of Bell & Tainter. In the latter, an auxiliary joint or feed screw was necessary, as already stated, to effectuate the required passage of the record over the point of the stylus, or to cause the stylus and reproducer diaphragm to travel across the surface of the record. In complainants' patent, on the other hand, it is shown that the lateral vibrations of the stylus point and the propelling of the same over the surface of the record without mechanical assistance and through the means of the groove alone was the primary object of the inventor. In the Suess Patent is contained a description corresponding to the features of Claim 35, in suit. The primary object of Suess, an employee
203 of Berliner, however, was merely to construct a suitable pivotal support for the diaphragm and stylus, so as to assist such device in its passage across the record. It is expressly stated in the specification of the Suess Patent that the invention relates to improvements in the reproducing apparatus of Berliner, and that the construction and mounting of the stylus form no part of the invention. The improvement of Suess, therefore, is not an anticipation. Defendant insists that the Bell & Tainter specifications fully described the Berliner process and specific combination. Such specification says:

> 204 "The invention consists, fourthly, in loosely mounting the reproducing style so that it is free to follow the record." And further: "Preferably the reproducing style, or rather what may be called the 'head' of the reproducing instrument is mounted on an universal point, and the style is pressed against the record by the yielding pressure of a spring or weight."

Stress is placed upon the language quoted; but from what has already been said regarding the Bell & Tainter Patent, it is manifest that the principle

of Berliner's invention rests upon the practicability 205
of propelling the stylus in the groove across the surface of the record without a feed screw or other mechanism. By such adaptation to what is known in the art as a zigzag record (Complainants' Record) certain imperfections in the talking machines were overcome, and sound, when reproduced, was rendered more intelligible. There was, I think, patentable novelty in the method which accomplished the results stated. The broad claims in suit in my judgment cannot be restricted to a record of even depth, such as described in the specification. The essence of such claims would seem to include a sound record, which, when in juxtaposition with a 206
diaphragm and stylus propelled in the manner described, is thereby enabled to successfully accomplish the primal object and purpose of the invention.

The next defences, prior use and abandonment, may be considered together. The proofs show that the patentee used his machine and gratuitously delivered a lecture on relation thereto in the City of Philadelphia on May 16th, 1888, to an audience of about two hundred persons, more than two years before the application in suit, and that prior thereto in the year 1887, he published an article in a periodical, the "Electrical World," relating to his said discovery. He expressly stated in his lecture that 207
the exhibit machine was the hasty result of a new mechanism and the accomplishment should be measured by its future possibilities and not wholly by the demonstration. It is not claimed that there were any sales of the instrument at the time of the exhibition and lecture; indeed, it is conceded that the apparatus was not sold nor used by other persons, until about six years later, when the patent in suit was issued. The mere exhibition of the machine to an assembled audience to hear an explanation of one's invention was not fatal to the patent

208 under the authorities (Shaw vs. Cooper, 32 U. S., 292; Egbert vs. Lippman, 104 U. S., 333; Elizabeth vs. Pavement Co., 97 U. S., 126; Eastman vs. Mayor, etc., of City of New York, 134 Fed., 844). That a complete disclosure was made of the described plan of mounting the reproducer diaphragm and stylus in the specification attached to the application filed November 7th, 1887, is freely admitted. Such disclosures consisted of a machine constructed in accordance with the drawing (Figure 10) of the earlier application. The diaphragm and stylus were mounted or suspended upon a conveyor arrangement having rollers. The inventor did not allow his invention, with his consent, to be embodied by other
209 persons in a completed machine, and no profit or gain, until the patent was granted, was realized as a result of the invention. Moreover, the evidence and circumstances justify the assumption that the exhibition of the apparatus was purely experimental and in no sense a public use within the meaning of the statutes. In Elizabeth vs. Pavement Co., *supra*, the Supreme Court considered the meaning and application of the words public use. In the opinion it is stated:

> "But if the inventor allows his machine to be used by other persons generally, either
> 210 with or without compensation, or if it is, with his consent, put on sale for such use, then it will be in public use and on public sale, within the meaning of the law. * * * Nicholson did not sell it, nor allow others to use it or sell it. He did not let it go beyond his control. He did nothing that indicated any intent to do so. He kept it under his own eyes, and never for a moment abandoned the intent to obtain a patent for it. In this connection it is proper to make another remark. It is not a public knowledge of his

invention that precludes the inventor from 211
obtaining a patent for it, but a public use or
sale of it."

This doctrine undoubtedly has application to the facts here. As already appears, the patent in suit was issued upon a later application than Patent No. 564586. Why the broad claims of the former were not made a part of the earlier application and specification does not appear. Defendant broadly contends that the fact of the omission by the patentee to claim the invention in the earlier application, considered in connection with the above mentioned publication in the "Electrical World," and public exhibition, was an abandonment and forfeit- 212
ure thereof. It is true that the Revised Statutes (S. 4886) require the inventor to point out and distinctly claim the improvement or combination which he claims is his invention or discovery. If he omits so to do, such improvement or combination being apparent on the face thereof, he is presumed to have abandoned the same and to have dedicated to the public that which is not claimed (Miller vs. Brass Co., 104 U. S., 350; James vs. Campbell, 104 U. S., 356; Stirrat vs. Excelsior Mfg. Co., 61 Fed., 980; McBride vs. Kingman, 97 Fed., 217). But it may be stated as a general rule that "a patent is never invalidated by the fact that the invention 213
claimed in it was described but not claimed in a patent granted subsequently to the making of the application for the patent secondly issued, but before it was granted." This principle as enunciated by Judge Blatchford in Singer vs. Braunsdorf, 7 Blatch., 521, is thought to apply. See also Thomson-Houston Elec. Co. vs. Elmira & Horseheads Ry Co., 69 Fed., 257. In any event, it cannot justly be claimed from the facts, that Berliner has done anything to indicate an intention to waive or surrender his discovery. To merely withhold a patent from the public has never been considered an aban-

214 donment, and the adjudged cases uniformly hold that an inventor may have a patent for an invention described but not claimed by him, in a prior patent to himself (Graham vs. McCormick, 11 Fed., 859; Vermont Farm Machine Co. vs. Marble, 19 Fed., 307; Eastern Paper Bag Co. vs. Standard Paper Bag Co., 30 Fed., 63). In the latter case the language of the Supreme Court, in Miller vs Brass Co., James vs. Campbell, *supra*, was interpreted as applying to re-issues under the statute. It was broadly held that the description of another invention in a prior patent by the same inventor does not forfeit his right to afterward take out a patent for such invention. In this case, the patent on the earlier
215 application, as has been stated, was issued subsequent to the patent in suit. I am unable to perceive how the patentee's failure to claim the invention described in his earlier application can be construed as an abandonment thereof. It is true an abandonment of an invention by a patentee to the public is a question of fact and may be established by the patentee's intention to abandon, or by inferences consistent therewith (Rifle and Cartridge Co. vs. Arms Co., 118 U. S., 22; Planing Machine Co. vs. Keith, 101 U. S., 479). The burden, however, is upon the defendant to show that the invention was abandoned (Wyeth vs. Stone, Fed. Cases, No. 18,
216 107). Nor, indeed, should evidence of abandonment rest upon doubtful or controverted inferences. The publication in the "Electrical World" is not entitled to the probative weight claimed by the defendant. The rule is that the prior publication, in order to anticipate, must fully and clearly describe the invention so as to enable the skilled in the art to completely understand it and reproduce the apparatus without assistance from the patentee (Badische Ainlin & Soda Fabrik vs. Kalls, 94 Fed., 163; Cohn vs. Corset Co., 93 U. S., 366). The prior publication, based upon the article mentioned, is

not within the rule stated. The elicited facts are thought to be foreign to sustaining the asserted defences, and hence, infringement not being controverted, complainants are entitled to a decree adjudging the validity of the patent and its infringement and for an injunction against the use of the machines or devices made in violation of Claims 5 and 35 of the patent in suit with costs. 217

UNITED STATES CIRCUIT COURT OF APPEALS,

SECOND CIRCUIT.

Before—LACOMBE, TOWNSEND and COXE, Circuit Judges. 218

VICTOR TALKING MACHINE COMPANY and another,
Complainants-Appellees,

vs.

AMERICAN GRAPHOPHONE COMPANY,
Defendant-Appellant.

219

This cause comes here upon appeal from a decree of the Circuit Court, Southern District of New York, sustaining the validity (and finding infringment) of U. S. Letters Patent 534543 granted February 19, 1895, to Emile Berliner for the "Gramophone." The opinion in the Circuit Court is reported in F. R.

Per Curiam.

In affirming this decree we do not find it necessary to add anything to the careful and exhaustive

220 discussion of the issues which will be found in Judge Hazel's opinion with one single exception. In disposing of the defence of prior public use based upon the lecture and exhibition before the Franklin Institute, the Circuit Court, apparently relied mainly upon the proposition that what took place there was not a public use, but rather an experimental one. Without discussing the questions thus raised or expressing any definite opinion either way, we prefer to dispose of the alleged prior public use by means of the application of Berliner which was filed six months prior to the Franklin Institute lecture, and which eventuated
221 in Patent 564586, issued subsequent to the patent in suit. The specifications in that application (for 564586) were full enough to warrant the making of the claims here in controversy (5 and 35); at any time the application might have been amended by adding such claims, and in our opinion it is immaterial that instead of thus amending it, he took the broader claims on another application filed while the first was pending. The second may fairly be considered a continuation of the first, and thus Berliner's application antedates the public use, and the facts will not sustain the contention that he abondoned his invention here in suit.

The decree is affirmed.

222

A true copy.

[SEAL.] (Signed) WM. PARKIN,
Clerk.

Circuit Court of the United States 223
Southern District of New York.
In Equity, No. 8797.
Suit on the Berliner Gramophone
Patent, No. 534543.

Victor Talking Machine Co., *et al.*
vs.
Leed & Catlin Co.

Complainants' Exhibit, *Per Curiam.*
(signed) ALEXANDER PARK,
[SEAL.] Notary Public, 224
Commission Expires Feb. 6, 1909.
604 Stephen Girard Bldg.,
Philadelphia.

(Filed March 27, 1906.)

225

226 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, vs. LEEDS & CATLIN COMPANY.	In Equity No. 8797.
VICTOR TALKING MACHINE COMPANY, *et al.*, 227 vs. TALK-O-PHONE COMPANY.	In Equity No. 8859.

State and County of New York, ss.:

Louis Hicks, being duly sworn, says: that he is solicitor and counsel for the Leeds & Catlin Company and for the Talk-o-Phone Company, the defendants above named. These two suits are brought upon Letters Patent of the United States No. 534543, dated February 19, 1895, to Emile Berliner. The suit against the Leeds & Catlin Company was brought in July, 1904, and the defendant duly appeared on the August, 1904 rule day. The suit against the Talk-o-Phone Company was brought at about the end of September, 1904, and the defendant appeared on the November, 1904, rule day. On September 30, 1904, in the suit against the Leeds & Catlin Company, and on December 19, 1904, in the suit against the Talk-o-Phone Company, demurrers were filed to the bills. As explained in the annexed correspondence between Horace Pettit, Esq., and

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me as counsel for the respective parties to these suits by reason of complainant's neglect, the demurrers were not reached for argument until October 23, 1905. The demurrers having been overruled prior to November 8, 1905, complainant delayed entering the orders overruling the demurrers and directing defendants to answer until requested so to do by deponent on or about November 22, 1905. Thereupon defendants filed their answers on December 21, 1905, but complainant neglected to file its replications on the January, 1906 rule day, and unreasonably delayed filing its replications until the February, 1906 rule day. Hence, these suits became at issue February 5, 1906, but complainants have taken no testimony whatever, although nearly three months have elapsed since the January, 1906 rule day. As appears from deponent's letters to Mr. Pettit, defendants vigorously protested against this delay. During the time of the delay complainant brought its suit against the American Graphophone Company to final hearing, secured a decision from Judge Hazel and an affirmance thereof by the Circuit Court of Appeals. As appears from my second letter to Mr. Pettit, dated November 22, 1905, I had repeatedly informed Mr. Pettit that I had discovered evidence which would without question prove the invalidity of that patent and I requested Mr. Pettit to proceed at once with the prosecution of its case against the Talk-o-Phone Company, in order that the question of the invalidity and nullity of the patent might, at an early date, be passed upon by the Court. 229 230 231

I was present at the argument on final hearing in the suit of the Victor Talking Machine Company *et al* vs. the American Graphophone Company on Berliner Patent No. 534543, on June 5 and 6, 1905, before Judge Hazel, and on defend-

232 ant's motion for rehearing before Judge Hazel on October 27, 1905, and also on the argument of the appeal in that suit in the Circuit Court of Appeals, on January 17 and 18, 1906. I have also examined the record and the briefs filed and used in the Circuit Court and the Circuit Court of Appeals in that suit. It appears that the defenses made were the following:

1. Anticipation by Bell & Tainter Patent No. 341-214.

2. Prior public use for more than two years before the application, based on Berliner's lecture
233 delivered May 16, 1888, before the Franklin Institute.

3. Abandonment, based on the article in the Electrical World for November 12, 1887.

4. Abandonment by acquiescence in Suess' United States Patent No. 427279.

5. That the patent in suit No. 534543 is not based on Berliner's invention, the construction shown being that shown in the Suess patent, and not that shown in Berliner's application filed November 7, 1887, for Patent No. 564586.

6. Claim 5 is not for a patentable method.

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It appears from the record in that suit that the bill was filed January 4, 1904; defendant appeared February 1, 1904; the answer was filed March 15, 1904, and the replication was not filed until August 12, 1904. A motion to apportion time was made and an order apportioning time to take testimony was filed February 7, 1905.

Complainants' *prima facie* case consisted of the bill of complaint; seven agreements, dated September 2, 1895 (2), October 4, 1895, October 15, 1895, November 1, 1895, September 28, 1901, and October

5, 1901, in regard to the title of the complainants to 235
the patent in suit, uncertified copies of which were stipulated in evidence without proof; the agreement of December 8, 1903 between the Victor Talking Machine Company and the American Graphophone Company, consent decrees in favor of the Victor Company, *et al.*, vs. Lit Brothers and against the Universal Talking Machine Company, *et al.*, on Berliner Patent No. 548623, recently held by Judge Hazel not infringed in a suit against the American Graphophone Company at final hearing; the file wrapper and contents on Berliner Patent No. 564586; Patent Office copies of the drawings of said Patent No. 564586; Berliner Patent in suit 236
No. 534543; Edison Patents Nos. 200521 and 227-679; stipulations admitting incorporation of complainants and defendant; the use of uncertified copies of the title papers mentioned and the use of Patent Office copies of patents; Complainants' Exhibits of Defendant's Machine and record, and stipulation that the same were made and sold subsequent to the patent and prior to the suit; the deposition of Joseph Lyons; and the deposition of Charles K. Haddon.

In rebuttal complainant took the deposition of Emile Berliner and the deposition of Rudolph M. Hunter and offered in evidence "Complainants' Exhibit Berliner Model" and a certified copy of Ber- 237
liner Patent No. 564586.

Defendant's case consisted of the answer; deposition of Shelton T. Cameron; deposition of Emile Berliner; Letters Patent of the United States Nos. 341214 and 341288, to Bell & Tainter; No. 427279 to Suess; No. 564586 to Berliner; No. 688739 to Jones; No. 562694 to Amet; English Patent No. 1644, of 1878 to Edison; French Patent No. 205-491 to Suess; article on Berliner's Gramophone in the Electrical World for November 12, 1887; pa-

238 per read May 16, 1888 by Emile Berliner on the Gramophone before the Franklin Institute; file wrapper and contents of patent in suit No. 534543; copies of affidavits of E. R. Johnson, verified December 14, 1900 and January 5, 1903, and stipulation as to translation of said Suess French patent.

Said Suess French patent is identical in all respects including the specification, drawings and claims with U. S. Letters Patent to Suess No. 427279.

Deponent introduces in evidence in each of the above entitled suits, and refers thereto and makes the same a part of this affidavit, a copy of the
239 agreement of December 8, 1903, between the Victor Talking Machine Company and the American Graphophone Company; Berliner Patent No. 564586; copies of the depositions of Emile Berliner taken by the defendant and by the complainant in rebuttal in said suit; Letters Patent of the United States No. 341214 and 341288 to Bell & Tainter; No. 427279 to Suess; English Patent No. 1644 of 1878 to Edison; a copy of the article on Berliner's Gramophone in the Electrical World for November 12, 1887; a copy of the paper read by Emile Berliner on the Gramophone before the Franklin Institute on May 16, 1888; a certified copy of the file wrapper and contents of the patent in suit No.
240 534543. For the drawings forming part of the article in the Electrical World for November 12, 1887, and of the paper read by Mr. Berliner on May 16, 1888, I beg leave to refer to the Exhibits filed in said suit between the Victor Company, *et al.*, and the American Graphophone Company, and annex hereto typewritten copies of the text or printed matter thereof.

As new matter, I offer in evidence on behalf of each defendant in the two above entitled suits a copy hereto annexed of the correspondence between complainants' counsel, Mr. Pettit, and me; the affi-

davit of T. Commerford Martin, verified November 241
10, 1905; the affidavit of Joseph Wetzler, verified November 9, 1905; a copy of an affidavit verified by Louis Hicks June 8, 1905, and two proposed orders based upon said affidavit, together with a letter dated June 10, 1905, by Horace Pettit, and a letter dated June 12, 1905, by Louis Hicks to Judge Hazel, with reference to said two proposed orders, neither of which was ever signed so far as deponent is informed; also an article in the Electrical World for August 18, 1888, entitled "The Improved Gramophone."

In addition, as new matter I offer in evidence certified copies of letters patent of France to Emile 242
Berliner, No. 186827, of November 8, 1887; No. 190602, of May 15, 1888, and No. 207090, of July 19, 1890, together with correct, true and full translations thereof hereto annexed, which translations I have personally made, being acquainted with the French language.

I further offer in evidence as new matter, certified copies of German Letters Patent to Emile Berliner No. 45048, of November 8, 1887; No. 47099, of May 16, 1888, and No. 53622, of November 20, 1889, together with correct, true and full translations thereof hereto annexed, which translations I have personally prepared, being acquainted with the German language. 243

I also offer in evidence as new matter a certified copy of Canadian Patent No. 41901, of February 11, 1893, to Emile Berliner, a certified copy of the assignment thereof from W. Suess to E. Berliner, and a certified copy of the petition, oath, powers of attorney, receipt, correspondence and wrapper relating to the application for said Canadian Patent.

I annex hereto copies of the material parts of the Law of France, of Germany, Great Britain and Canada, in force at the time the aforesaid letters patent of France, Germany and Canada were ap-

244 plied for and granted, and at the time English Letters Patent No. 15232 of 1887, No. 7204 of 1888, to Emile Berliner, which are herewith offered in evidence, were applied for and granted.

It appears from Vols. 8 and 9 of the Official Journal, published at the Patent Office, Sale Branch, London, England, for July, 1887, to June, 1888, that the application for English Patent No. 15232, of November 8, 1887, was filed November 8, 1887; that the complete specification was accepted December 10, 1887, and published during the week ending December 31, 1887, at a price of 11d. per copy; that the patent thereon was sealed February 17, 1888.

245 It furthermore appears from Vols. 9 and 10 of the same journal for January, 1888, to December, 1888, that the application for English Letters Patent No. 7204, of May 15, 1888, was filed May 15, 1888; that the complete specification was accepted June 16, 1888, and published during the week ending July 7, 1888, at a price of 6d. per copy; and that the patent thereon was sealed August 24, 1888.

I have for the past ten years been actively engaged in the practice of patent law, and during the greater part of that time I have devoted my attention largely to patents and litigation relating to talking machines. The patent in suit, No. 534543, to Berliner states that "one feature of my inven-

246 tion has reference to improvements in the method of recording sound by tracing upon a fatty film, etc.; while the other features of my invention have reference to the construction of the details of both the recorder and the reproducer of the gramophone. Each of these features of improvement are designed to overcome certain difficulties, and to avoid certain imperfections heretofore met with in the operation of the gramophone" (p. 1, lines 17-31). On page 3, beginning at line 3 and continuing down to line 109, Berliner described those features of his invention which have reference to the recorder or

recording sound-box. On page 5, beginning at line 247
34 and continuing down to line 102, Berliner describes those features of his invention which have reference to the reproducer or reproducing sound-box. The recorder consists of a diaphragm mounted in a casing, of a lever or spring constituting or carrying a stylus, the lever being composed of two parts joined or placed at right angles, the one to the other, and of means for connecting the lever or spring with the diaphragm, and of regulating the tension between the diaphragm and spring. The recording stylus is normally curved, but is unbent and becomes straight when adjusted upon the record tablet preparatory to making a record. One end
of the spring or lever is made fast to the casing hold- 248
ing the diaphragm and the other end is free to vibrate. For the purpose of dampening the individual vibrations of the lever carrying the stylus, one or two bands of soft rubber are slipped over the broad portion of the stylus. The lever and stylus may extend across the diaphragm upon a line constituting a chord but in the arrangement shown in figure 4 the adjustment can be such that they may extend across the diaphragm upon a line which would constitute a diameter of the circle of the diaphragm. This eccentricity of the lever and recording stylus is no essential part of Berliner's recorder or recording sound-box, but, as will hereafter more 249
clearly appear, is a mere modification or improvement thereon, which is claimed in claims separate and distinct from Claims 6, 7, 8, 9, 10 and 16, for example, wherein the main and principal features of the recorder are claimed without reference to the eccentricity referred to.

The reproducer or reproducing sound-box consists of a diaphragm mounted in a frame or casing, of a leaf spring similar to the leaf spring of the recorder, and which likewise faces with its flat side the face of the diaphragm up to a point beyond the

250 center of the latter, and is then turned or twisted at right angles and crosses the casing edgewise (p. 5, lines 43-47). The lever or leaf spring of the reproducer carries at its free end the reproducing stylus, attached in the manner shown and described. One end of the leaf spring or lever of the reproducer is secured to the casing and the other end is free to vibrate, and the leaf spring or lever is said to be elastic in two directions at right angles to each other, by reason of the right angular twists given to the leaf spring at its middle (p. 5, lines 51-52). At the point where the leaf spring passes over the center of the diaphragm it is connected with the diaphragm and in such manner that the ten-
251 sion between the leaf spring and the diaphragm can be regulated (p. 5, lines 61-71). In order to dampen the individual vibrations of the spring, as in the case of the spring of the recorder, a piece of soft rubber may be used to embrace the end of the spring (p. 5, lines 59-61). In order to reduce the volume of sound, one or more perforated and exchangeable diaphragms may be placed in the neck or tube leading from the diaphragm (p. 5, lines 90-102).

That part of Berliner's invention relating to his recorder is illustrated in Figures 4 and 5, and that part relating to his reproducer or reproducing
252 sound-box is illustrated in Figures 6 and 7. Reference to Figure 1 shows that in the recording gramophone shown in Figure 1, the improvement in the details of the recorder or the recording sound-box are illustrated, and the recording stylus is a leaf spring consisting of two parts at right angles one to the other, connected with the center of the diaphragm and having a stylus which is normally curved but which has become straight when brought into adjustment with the record tablet. Reference to Figure 3, showing the reproducing apparatus as a whole shows that Berliner's improvements in the

details of the reproducer or reproducing sound-box have been incorporated in Figure 3 where the reproducing sound-box consists of the diaphragm and the leaf spring or lever consisting of a spring bent at about the middle so that the two parts are at right angles the one to the other, the spring being connected to the center of the diaphragm and at one end being attached to the casing, and at the other end being free to vibrate and carrying at the free end the reproducing stylus affixed in the manner shown and described. Claims 24, 25, 26, 27, 28, 29, 30, 31, 33, 34 and 35 claim in one form or another Berliner's invention consisting of improvements in the details of his reproducer or reproducing sound-box. 253 254

Referring to German Patent No. 53622, of November 20, 1889, and to the annexed translation thereof, it appears that Berliner by this patent patented in Germany that part of his invention set forth in Patent No. 534543, constituting his improvements in details of the reproducer. The drawing of the German patent is substantially identical with Figures 6 and 7 of the patent in suit No. 534543. Reference to the specifications of the two patents is hardly necessary to make this appear more clearly than it does from a comparison of the drawings alone. However, referring to the translation hereto annexed of this German patent, it appears that there are described the same diaphragm mounted in a frame or casing, the same leaf spring fastened at one end and free to vibrate at the other end and bent somewhere about the middle at right angles, so that the fastened part extends with its flat part parallel to the diaphragm while the free end of the spring stands with the principal face perpendicular to the diaphragm. The spring and the diaphragm are likewise connected at the center of the diaphragm as in the United States patent, and means for adjusting the tension between the spring and the diaphragm are likewise provided. 255

858

256 The reproducing stylus carried by the free end of the spring is secured in the same manner as in the United States patent. And finally the function and mode of operation of the reproducer of the German patent and the reproducer of the United States patent are identical, and the two patents disclose and claim the one and the same invention.

Referring now to Berliner French Patent No. 207090, of July 19, 1890, and to the annexed translation thereof, it appears that by this patent Berliner patented in France not only the features of his invention having reference to the construction of the details of his reproducer or reproducing sound box, but also the features having reference
257 to the construction of the details of his recorder or recording sound-box. Figures 6 and 7 of the United States Patent No. 534543 show the identical reproducer shown in Figures 3 and 4 of the French patent and Figures 4 and 5 of the United States patent show the same recorder as that shown in Figures 1 and 2 of the French patent, the only difference being substantially in the detail, that in the United States patent the lever and stylus are eccentric, while in the French patent the lever and stylus of the recorder are along the line of a diameter. The essential features of the two recorders are identical, and the invention of the
258 French patent is the principal invention of the United States patent as regards the recorder as well as the reproducer. Referring to the annexed translation and drawings of the French patent, it appears that in the reproducer there is the same diaphragm in the same casing; the same spring or lever composed of two parts placed at right angles the one to the other, or bent at right angles, the same rings of rubber to dampen the individual vibrations of the springs, the same connection between the spring and the center of the diaphragm, like means for regulating the tension between the

spring and the diaphragm, the same means 259
for attaching the reproducing stylus at the end of the spring, the same perforated diaphragms in the neck or tube of the reproducer (Figure 3, D), to render the tone more clear, and that the reproducer of the United States and of the French patent operate according to the same principle, perform the same function, have the same details of construction, and are embodiments of one and the same invention. With reference to the recorder shown in the French patent, we have the same diaphragm in the same casing or frame, the same spring or lever composed of two parts the one at right angles to the other (and 260
here it will be noticed that in the reproducer of the United States and of the French patent, the spring is bent or twisted so as to make the parts at right angles, while the spring or lever of the recorders are composed of two parts joined together so as to be at right angles the one to the other), the same rings of rubber about the stylus or spring of the recorder, similar connection of the spring to the center of the diaphragm, and similar means for regulating the tension between the spring and the diaphragm, the same stylus curved in normal position and unbent so as to become straight when brought in contact with the record tablet. In the recorder of the French patent as well as in the re- 261
producer, there is the same fastening of one end of the spring to the casing of the diaphragm and the same freedom of vibration of the other end of the spring so that the recorder of the United States and French patents embodying one and the same invention, are constructed on the same principle, perform the same function or mode of operation, and are made up of the same details of construction. The principal invention of the recorder of the United States patent is found in the French

262 patent, and the principal invention of the French patent is found in the United States patent and claimed in each, although, as appears from the French Patent Law hereto annexed, claims of a French patent form no essential part of the patent, the requirement being that there be a specification of the invention forming the subject of the patent applied for.

Referring to letters Patent of Canada, No. 41901, of February 11, 1893, to Emile Berliner, assignee of Werner Suess, for improvements in gramophones, it appears that the drawings and description thereof are substantially identical with
263 the description and drawings of the United States Patent No. 427279 of May 6, 1890, to Emile Berliner, assignee of Werner Suess, for improvements in gramophones. The claims of the two patents are, however, radically different. The United States patent sets forth five claims, each one of which except Claim 4, is for a combination, comprising in addition to other elements, a freely swinging support frame, or, as Judge Hazel puts it in his opinion in the suit against the American Graphophone Company on Berliner Patent No. 534543, "a suitable pivotal support," and a weight adjustable on said frame to counterbalance the reproducer mechanism; while Claim 4 is for a com-
264 bination comprising the freely swinging supporting frame and a system of links, in addition to other elements. It, therefore, appears that the claims of the United States patent are exceedingly narrow, and Judge Hazel held that the "improvement of Suess, therefore, is not an anticipation," saying:

> "In the Suess patent is contained a description corresponding to the features of Claim 35 in suit. The primary object of Suess, an employee of Berliner however, was merely to construct a suitable pivotal

support for the diaphragm and stylus, so as to assist such device in its passage across the record. It is expressly stated in the specification of the Suess patent, that the invention relates to improvements in the reproducing apparatus of Berliner, and that the construction and mounting of the stylus form no part of the invention. The improvement of Suess, therefore, is not an anticipation." 265

In the record before Judge Hazel, letters patent of the United States No. 372786 of November 8, 1887, and No. 382790 of May 15, 1888, both granted to Emile Berliner, were not in evidence, and these patents are the ones mentioned in the Suess Patent No. 427279 (P. ls, 8-14), as the ones setting forth Berliner's "reproducing apparatus adapted for use in the method for recording and reproducing sounds" for improvements upon which Suess obtained his patent. Said Letters Patent Nos. 372-786 and 382790 to Berliner are herewith offered in evidence, and an examination of those two patents shows that Suess' invention was an original departure from the reproducing apparatus set forth in said Berliner patents. Had the said two Berliner patents been in evidence, Judge Hazel would have seen how marked was the improvement which Suess made upon Berliner's reproducing apparatus. The construction and mounting of the stylus, which, as Judge Hazel states, Suess declared to be "no part of the present invention" (p. 2, ls. 33-34), relate to the construction of the reproducer or reproducing sound-box merely. I have secured a certified copy of the application of Suess, assignor to Berliner, for Letters Patent No. 427279, and of the file-wrapper and contents of said patent, and it appears therefrom that the application was allowed as filed 266 267

268 without any amendment or correspondence whatever relating thereto. I concluded, and from correspondence had with the Patent Office, in regard thereto, I allege upon information and belief that a previous application had been made by Suess and abandoned, and that the subsequent application upon which the patent was issued was then made. I have, however, been unable to obtain a copy of the abandoned application from the Patent Office, the same or any information thereof having been refused.

Referring now to the claims of the Canadian patent, they are thirteen in number, and obviously the Canadian Patent No. 41901 covers broadly the in-
269 vention set forth in Claims 5 and 35 of the Berliner Patent in suit, No. 534543. Special reference is made to Claims 11, 12 and 13. A comparison of Claim 11 with the other claims of the patent shows that Suess claimed broadly the alleged invention of Berliner Patent No. 534543. As Judge Hazel said that "in the Suess patent is contained a description corresponding to the features of Claim 35 in suit," and as the drawings and specifications of the Suess United States and Canadian patents are substantially identical, it is unnecessary to point out further that the Suess Canadian patent discloses the alleged invention of Claims 5 and 35 of
270 the Berliner Patent in suit No. 534543. Hence, Claims 5 and 35 are limited to the special form of reproducing sound-box and stylus described in Patent No. 534543, and claimed therein and described in the French and German Berliner patents above referred to. On page 3 of the Canadian patent Suess says:

> "The stylus engaging with its point the record groove, is controlled by the walls of the latter, and, as will be hereinafter more fully shown, I rely upon this control of the

stylus by the walls of the record groove for the movement of the stylus across the face of the disc, there being no positive feeding mechanism for thus moving the stylus." 271

Referring to English Letters Patent No. 15232, of 1887, and comparing the description, drawings and claims thereof with letters patent of the United States No. 564586, to Berliner, granted July 28, 1896, but applied for November 7, 1887, and stating on its face that it was patented in England on November 8, 1887, by said English Letters Patent No. 15232 of that date, it appears that the two patents are for one and the same invention, except that the English patent, in addition to covering the matter of the United States patent, also covers the matter of Berliner's early United States Patent No. 372786, of November 8, 1887. This is too clear to require further discussion. It may be remarked in passing, however, that Claim 9 of the English patent is substantially identical with Claim 8 of the United States patent; that Claim 12 of the English patent is the same as Claim 9 of the United States patent; that Claim 13 of the English patent is the same as Claim 10 of the United States patent; that Claim 14 of the English patent is the same as Claim 13 of the United States patent, etc. The two patents, therefore, unquestionably cover the same invention. 272 273

In the United States Patent No. 564586, Berliner first describes the drawings showing his apparatus, from page 2, line 7, to page 3, line 54. He then describes the deposition of a suitable layer of ink upon the tablet and the making thereon of a phonautographic record by the recording machine and the copying of that record by photo-engraving, from page 3, line 55, to page 4, line 45. He then describes the centering of the copied record upon the metal disc, from page 4, line 46, to page 4, line 80. Berliner then states that "the stylus is then ad-

274 justed with its point in engagement with the outer end of the record groove, and the weight, 26, is allowed to descend. It will now be clear that the stylus will be forced possibly to follow the undulations of the record, and that the diaphragm vibrating under the stylus will emit the same sounds which produced the original record, which sounds can be distinctly heard at the ear-piece 34.

"Both the process and the apparatus thus far described may be modified in various ways without departing from the main features of my invention. So, for instance, I can dispense with the centering device and can rotate the record upon a stationary axis, if the diaphragm with its attached stylus is
275 mounted in a manner to make it follow the spiral record. An arrangement of this character is shown in Fig. 10. The reproducing disc 54 is in this case mounted as hereinbefore described, but without regard to the centering device. The support 7′ may be fixed in position so that the bevel-gear 9, mounted upon the same in the manner described with reference to Fig. 3, will turn without progressive motion. Bevel-gear 9 and with it the reproducing-disc 54, are rotated by a bevel-gear 14′ upon a shaft 6′, to which power is applied by a weight, as shown, or in any other suitable manner. The diaphragm-casing 31 is secured to a small truck 55 upon rails 56 ar-
276 ranged vertically above and parallel with a diameter of the reproducing-disc, and at such height above the same that the stylus 29 will be in engagement with the undulatory grooves of even depth which represent the record of sounds.

"The listener applies his ear to the ear-piece, and when the shaft 6′ is rotated the stylus and diaphragm will be forced to vibrate, as in the apparatus shown in Fig. 1, but will at the same time move with the truck 55 across the face of the disc 54. A tolerably good reproduction may also be obtained by simply holding one end of a reed be-

tween the teeth and the other pointed end of the same in engagement with the record-grooves while the disc is rotated." 277

It will be noticed that Berliner states that the apparatus or arrangement shown in Figure 10 is a mere modification of his process and apparatus "without departing from the main features of my invention." So in referring to Figure 10, on page 2, line 22, Berliner says: "Figure 10 is a sectional elevation of a modified form of my reproducing apparatus." Clearly, according to Berliner's statements, the modified arrangement shown in Figure 10 embodies the main features of his invention disclosed in the entire specification. This view was also taken by the Circuit Court of Appeals in the opinion affirming the decision of Judge Hazel in the suit of the Victor Company, *et al.*, vs. the American Graphophone Company. In that opinion the Circuit Court of Appeals said: 278

> "The specifications in that application (for 564586) were full enough to warrant the making of the claims here in controversy (5 and 35); at any time the application might have been amended by adding such claims, and in our opinion it is immaterial that instead of thus amending it he took the broader claims on another application filed while the first was pending. The second may fairly be considered a continuation of the first." 279

We have, therefore, in the United States two patents protecting the features of Berliner's invention set forth in his application for No. 564586, to wit: No. 534543 as to Claims 5 and 35 and the various claims of No. 564586.

It should be noticed that in Claims 17, 18, 19, 20, 21 and 22 of Patent No. 534543, Berliner mentions a "rotary tablet," while in Claim 35 Berliner speaks of a "traveling tablet." In the claims of

280 United States Patent No. 564586 (Claims 1, 2, 3, 4, 7, 8 and 13, for example), and in the claims of English Patent No. 15232, of 1887 (Claims 1, 4, 5 and 9, for example), the word "traveling" denotes a tablet or support which not only rotates, but also has a progressive movement of its center. Thus Claim 35, which the Circuit Court of Appeals says is a broad claim for the invention set forth in No. 564586, and therefore in said English Patent No. 15232 of 1887, follows the language of No. 564586 in the use of the word "traveling" and the expression "traveling tablet."

Claim 8 of No. 564586 reads as follows:

281 "8. In a gramophone, the combination of a sound-receiving sonorous body; with a pivoted stylus controlled by and controlling the same, and a support adapted to carry a phonautogramic recording-surface, or a copy of such record in solid resisting material, travelling in the plane of vibration of the point of the stylus; substantially as described."

Claim 9 of English Patent No. 15232 of 1887, reads as follows:

"9. In a gramophone, the combination of
282 a sound receiving diaphragm or other sonorous body; with a pivoted stylus controlled by a diaphragm, and controlling the same, and a support adapted to carry a phonautographic record sheet or a copy of such record, in solid resisting material, traveling in the plane of vibration of the point of the stylus, substantially as described."

Claim 35 in suit of Patent No. 534543 reads as follows:

"35. In a sound reproducing apparatus

consisting of a traveling tablet having a 283
sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described."

Obviously the combination shown in the last Claim, 35, is but a mere modification of the combination shown in the two previous claims above set forth, 8 and 9. And that is what Berliner himself states and what the Circuit Court of Appeals has also held. Claims 5 and 35 of Patent No. 534543 therefore, protect the same invention as English Patent No. 15232 of 1887. 284

Referring to German Patent No. 45048 of November 8, 1887 and to the annexed translation thereof, and French Patent No. 186827 of November 8, 1887 and to the annexed translation thereof, it appears upon the face of these patents that they are for the same invention as English Patent No. 15232 of 1887, the French patent including the claims, being a mere translation thereof, and the German patent being for the same invention in slightly different language. The drawings of the English, French and German patents being all identical.

I have for several years past made a careful study 285
of talking machines, of patents relating thereto, and have frequently been called upon to give opinions with reference to patents relating to talking machines and to take a very active part in litigation based upon such patents. I have discussed the foregoing patents and the subject matter thereof with Mr. Edward F. Leeds, of Leeds & Catlin Company, and Mr. Harry Ensign of the Talk-o-Phone Company, experts in the talking machine art, and I believe that the conclusions above stated by me are correct, together with the reasons given therefor.

286 The Talk-o-Phone with the mechanical feed device (Exhibit A) herewith presented to the Court, was, in its general form, first suggested by me. My suggestion was based especially upon English Patent No. 1644, of 1878 to Edison, and especially on Figures 1-10 thereof and upon the other early letters patent herewith offered in evidence, showing the positive feeding mechanism for moving a reproducing stylus or other like instrument across the face of the record. As stated by Suess in his United States and Canadian patents in the apparatus shown by him there is "no positive feeding mechanism for thus moving the stylus across the
287 record." Complainants' counsel, Mr. Pettit, under date of March 10, 1906, as appears from his annexed letter to Rogers Manufacturing Company, claims that the mechanical feed device can have no useful function to perform and is a mere attempt to evade the Berliner patent. Obviously Mr. Pettit's contention is contrary to the fact, and is made for the purpose of injuring the Talk-o-Phone Company. I annex a copy of the description forming a part of the application filed on behalf of the Talk-o-Phone Company for letters patent covering the special features of its talking machine with the mechanical feed device. The first action of the
288 Patent Office thereon, dated March 8, 1906, shows that no objection is made by the Patent Office to Claims 8, 9, 10 and 16, covering the mechanical feed device of the Talk-o-Phone Company's Talk-o-Phone manufactured in accordance with the invention described in said application, and that only a formal objection has been made to Claim 17 for the same device. The claims mentioned, will, therefore be allowed and upon further action in the proceedings it is believed that all or nearly all of the remaining claims will be allowed.

I have been familiar with the product of the

Talk-o-Phone Company since the time of its incorporation. The Talk-o-Phone Company is now and has been engaged in the manufacture and sale of talking machines and is not and has not been engaged in the manufacture of sound records. 289

Referring to the Talk-o-Phone with the mechanical feed device, it appears from an inspection of Exhibit A, as well as from the specification of the application for a patent therefor hereto annexed, that the walls of the record groove cannot move the stylus across the face of the record and that the movement of the stylus across the face of the record groove is performed by the mechanical feed device. 290

LOUIS HICKS.

Subscribed and sworn to before me this 5th day of April, 1906.

T. P. Dalton,
Notary Public,
Kings Co.

[NOTARY'S SEAL.]

Cert. filed in New York Co.

291

292 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, vs. LEEDS & CATLIN COMPANY.	In Equity No. 8797.
VICTOR TALKING MACHINE COMPANY, *et al.*, 293 vs. TALK-O-PHONE COMPANY.	In Equity No. 8859.

State and County of New York, ss.:

Harry Ensign, being duly sworn, says: I reside at Toledo, Ohio, and am the Superintendent of the Talk-o-Phone Company, defendant above named, and have entire charge of the manufacture of talk-o-phones in the factory of the Talk-o-Phone Company at Toledo, Ohio, where all the talking ma-
294 chines of that Company are and have been made. The Talk-o-Phone Company is an Ohio corporation having authorized capital stock in its certificate of incorporation of Five hundred thousand dollars ($500,000), of which Four hundred thousand dollars ($400,000) have been issued, and the Talk-o-Phone Company has already increased the amount of its capital stock authorized to $1,000,000 and the amount of the issue thereof. Several hundred thousand dollars have been invested by the Talk-o-Phone Company in its factory and plant at Toledo, Ohio, and the attacks made by the

complainant herein, together with their misleading circulars and statements to the trade, and their delay in bringing this suit to a hearing have seriously injured the business of the Talk-o-Phone Company. For the past three years I have been engaged in the manufacture of talking machines, principally for the Talk-o-Phone Company, and I am familiar with the principle of construction and the mode of operation of all parts of talking machines and particularly disc talking machines, such as the Talk-o-Phones. I am also familiar with the construction, principle and mode of operation of the disc talking machines made and sold by complainant, the Victor Talking Machine Company, and by the American Graphophone Company. I also undertsand and am familiar with the talking machines described in letters patent of the United States to Berliner, Nos. 534543, 564586, 372786 and 382790, and in Berliner's corresponding English patents, No. 15232 of 1887 and No. 7204 of 1888; and with Berliner's corresponding French Patents No. 186827 of November 8, 1887, No. 190602 of May 15, 1888 and No. 207090 of July 19, 1890; also with Berliner's corresponding German patents Nos. 45048, of November 8, 1887, 47099, of May 16, 1888 and 53622, of November 20, 1889. I am also familiar with the Berliner-Suess Canadian Patent No. 41901 of February 11, 1893. and with other patents to various inventors for talking machines. I have given special attention in the course of my business to the manufacture of sound boxes consisting of a diaphragm with a recording or reproducing stylus connected therewith for use in disc talking machines. 295 296 297

Referring to the patent in suit to Berliner, No. 534543, Berliner states (p. 1, ls. 17-31) that "one feature of my invention has reference to improvements in the method of recording sound by tracing upon a fatty film, etc.; while the other features of my

298 invention have reference to the construction of the details of both the recorder and the reproducer of the gramophone. Each of these features of improvement are designed to overcome certain difficulties, and to avoid certain imperfections heretofore met with in the operation of the gramophone." By the "recorder" and "reproducer" are meant the recording and the reproducing sound boxes shown in Figures 4, 5, 6 and 7 of the drawings of that patent. Berliner describes his recorder on page 3, lines 3-109, and his reproducer on page 5, lines 34-102.

The recorder described in the patent consists of
299 a diaphragm mounted in a casing connected with the lever carrying a recording stylus and extending over the face of the diaphragm. The lever and stylus consists of two parts joined together so that the parts are at right angles, the face of the one to the face of the other. In normal position the stylus is curved, but is unbent and becomes straight when adjusted in position preparatory for the making of a record. Bands of rubber or the like surround the stylus to dampen the individual vibrations thereof. One end of the lever and stylus is fixed or fastened to the casing, while the other end or point of the stylus is free to vibrate. The recorder
300 is shown in Figures 4 and 5, and it appears from those figures that the lever and stylus may be adjusted along the line of a diameter of the circle of the diaphragm. Means are provided for regulating the tension between the lever and the diaphragm. With the exception of unimportant details including the eccentricity referred to, the same recorder or recording sound-box is shown and described and claimed in French patent to Berliner No. 207090 of November 11, 1890. This appears not only from the description of the two patents, but also from a comparison of Figures 4 and

5 of U. S. Patent No. 534543 with Figures 1 and 2 301
of the French patent. The essential features of construction of the one constitute the essential features of the other. The principles and modes of operation of the two are alike, and the two embody and operate according to the one and the same invention. The eccentricity of the lever shown in Figure 4 of the United States patent is not a qualification or limitation of the foregoing statements, for the reason that such eccentricity is a mere modification or improvement upon the main features which are claimed without the eccentricity in the United States patent in Claims 6, 7, 8, 9, 10 and 16, for example. Berliner's reproducer shown 302
in Figures 6 and 7 of the United States patent consists of a diaphragm mounted in a casing connected with the leaf spring or lever carrying at one end a reproducing stylus, which end is free to vibrate, while the other end is fixed to the casing. The leaf spring or lever consists of two parts bent at right angles, the one to the other at about the middle, and means are provided for adjusting the tension between the diaphragm and the lever. In the tube attached to the reproducer one or more perforated diaphragms (114) are placed for the purpose of lessening or rendering more clear the sound given out. A comparison of the description of the reproducer and of Figures 6 and 7 of 303
the United States patent with the description and Figures 3 and 4 of the French patent, and with the description and drawings of German Patent to Berliner No. 53622, of November 20, 1889, show that the reproducer of the American patent and of the French and German patent are identical as to the details of construction, the functions, principle and mode of operation, and that one and the same invention is embodied in each and claimed in each of the three patents.

Referring to Canadian Patent No. 41901, of Feb-

304 ruary 11, 1893, to Berliner, assignee of Suess, this Canadian patent is identical in its drawings and description with the United States Patent No. 427279, of May 6, 1890, to Berliner, assignee of Suess, except that there is a slight difference of arrangement of the paragraphs of the description, and except that there is a radical difference between the claims of the two patents, the claims of the Canadian patent being of the broadest possible character, referring especially to Claims 11, 12 and 13, for example, and particularly to Claim 11. In the Berliner-Suess Canadian and United States patents it is said:

305 "The stylus engaging with its point the record groove, is controlled by the walls of the latter, and as will be hereinafter more fully shown, I rely upon this control of the stylus by the walls of the record groove for the movement of the stylus across the face of the disc, there being no positive feeding mechanism for thus moving the stylus."

This movement is broadly claimed in Claim 11, for instance, of the Canadian patent, which reads as follows:

"11. In an apparatus for reproducing sounds from a rotating record tablet, a re-
306 producing stylus mounted to have a free movement over the surface of the record tablet, substantially as described."

The Suess apparatus is substantially identical with talking machines of that class upon the market not provided with feed mechanism or feed screws to move the stylus across the face of the disc, but depending upon the walls of the rotating record for that purpose. Referring to Figure 3 of the patent in suit, No. 534543, the apparatus there shown by Berliner and described at p. 4, line 95,

to p. 5, line 33, is purely and simply the apparatus 307
shown and described and claimed in the Berliner-Suess Canadian and United States patents, except that the reproducer carried by the end of the arm, 88, and connected with the horn, 94, 95, is the reproducer shown in Figures 6 and 7 of the Berliner Patent in suit No. 534543. That is to say, the only difference between Figure 3 of the patent in suit and the Suess machine of the Berliner-Suess Canadian and United States patents, is that Berliner has introduced improvements in the details of construction of the reproducer, and this, I understand, is what Berliner meant when he said in the part already quoted, that the features of his invention 308
had reference to the "construction of the details of both the recorder and reproducer of the gramophone." With this exception, therefore, the exception of the details referred to of the reproducer shown in Figures 6 and 7 of Patent No. 534543, the reproducing apparatus of Berliner as a whole, its principle and mode of operation shown in Patent No. 534543, is identical with, and is in fact nothing but the Suess apparatus of the Berliner-Suess Canadian and United States patents.

Passing now to Berliner Patent No. 564586, of July 28, 1896, it appears from the statement thereof, that the invention was patented in England by English Patent No. 15232, of November 8, 1887. A 309
comparison of the Berliner French and German Patents No. 186827, of November 8, 1887, and No. 45048, of November 8, 1887, with English Patent No. 15232, of 1887, shows that the drawings of the three patents are identical, that the French patent, including the claims thereof is a literal translation of the English patent, and that the German patent describes exactly the same things in slightly different language. In the United States patent Berliner first describes the drawings, from page 2, line 7, to page 2, line 54. With the exception of Figure

310 10, these same drawings are shown in the said English, French and German patents, and at page 2, line 22, of the United States patent, Berliner says, "Figure 10 is a sectional elevation of a modified form of my reproducing apparatus." From page 3, line 55, to page 4, line 45, of the United States patent, Berliner describes the deposit of a film of ink upon the traveling tablet and the drawing of a phonautographic record thereon, and the copying of that record in solid resisting material. From page 4, line 46, to page 4, line 89, Berliner describes the reproducing of the original sounds by his apparatus shown in the figures other than Figure 10. He says (p. 4, lines 80-89): "The stylus is then ad-
311 justed with its point in engagement with the outer end of the record groove, and the weight, 26, is allowed to descend. It will now be clear that the stylus will be forced positively to follow the undulations of the record, and that the diaphragm vibrating under the stylus will emit the same sounds which produced the original record, which sounds can be distinctly heard at the ear-piece 34." This identical language is found in English Patent No. 15232, of 1887, at page 8, lines 44-50 thereof, and is, of course, found in the French patent, which is a translation thereof, and substantially the same thing is stated in the corresponding German patent
312 (see paragraph last but one preceding the patent claims). Broadly Berliner's invention so described in the United States Patent No. 564586 and in the said corresponding English, French and German patents is claimed in the patent in suit No. 534543 in Claims 5 and 35 thereof, which read as follows:

> "5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same along the record by and in accordance with the said record, substantially as described."

"35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described." 313

This, I understand, is what the Circuit Court of Appeals meant, when, in its opinion in the suit of the Victor Talking Machine Company, *et al.*, vs. The American Graphophone Company it said:

"The specifications in that application (for 564586) were full enough to warrant the making of the claims here in controversy (5 and 35); at any time the application might have been amended by adding such claims, and in our opinion it is immaterial that instead of thus amending it he took the broader claims on another application filed while the first was pending. The second may fairly be considered a continuation of the first." 314

I am confirmed in my opinion as to this point by the statement with which Berliner continues the description of his invention. Continuing from page 4, line 89, he says:

"Both the process and the apparatus thus far described may be modified in various ways without departing from the main features of my invention * * * an arrangement of this character is shown in Figure 10." 315

It is thus perfectly clear that Claims 5 and 35 carried from the specification of Patent No. 564586 to the specification of the patent in suit No. 534543 cover and protect the invention, the identical invention claimed in United States Patent No. 564586, and in the corresponding English, French

316 and German patents mentioned. Claims 8, 9, 10 and 13 of Patent No. 564586 are identical or substantially identical with Claims 9, 12, 13 and 14 of the English and French patents, and the preceding method claims of the three patents are so clearly alike in the United States, English and French patents, that it is unnecessary to make any analysis of them, while the corresponding German patent claims the same things and methods according to the German practice. Claim 9, for instance, of English Patent No. 15232, of 1887, reads as follows:

> "9. In a gramophone, the combination of a
317 sound receiving diaphragm or other sonorous body; with a pivoted stylus controlled by a diaphragm, and controlling the same, and a support adapted to carry a phonautographic record sheet or a copy of such record, in solid resisting material, travelling in the plane of vibration of the point of the stylus, substantially as described."

It is perfectly clear that Claim 9 quoted from the English patent is inseparably connected with the invention described in Claims 5 and 35 of Patent No. 534543, and that the invention described and claimed in Claims 5 and 35 of the patent in
318 suit is inseparably connected with Claim 9 of the English patent. They are, indeed, for one and the same invention, made at the same time prior to Berliner's application filed November 7, 1887, in the United States for Patent No. 564586, forming part of one and the same inventive act, differing perhaps in scope, but being for essentially the same invention and including, as Berliner himself states, all the main features of his invention.

With reference to the reproducing apparatus shown in Figure 10 and described in lines 90-128 on page 4 of Berliner Patent No. 564586, I am clearly

of the opinion that such reproducing apparatus could not reproduce the sound recorded in a sound record. I am familiar and have for several years been familiar with talking machines put upon the market, and I have never seen a talking machine operating as the reproducing apparatus in Figure 10 is said to operate, nor have I ever heard of a machine so operating, and from my practical knowledge of talking machines acquired from the manufacture thereof on a large scale, I am able to state that the reproducing apparatus shown in Figure 10 is inoperative. For the following obvious reasons, well known to any person skilled in the art and apparent to any person who may familiarize himself with the subject matter, the apparatus shown in Figure 10 is incapable of reproducing sound recorded in a sound record. These reasons are: 319 320

First. The tube, 33, attached to the sound-box, 31, carrying at its end a flaring portion, is without any support whatever, except for its attachment to the sound-box, and no means are shown or suggested for the support of the tube. Therefore, the weight of the tube bearing upon the sound-box would throw the stylus, 29, out of adjustment with the groove of the sound record, and it would be impossible in the apparatus shown to keep the stylus in the groove of the record, because of the constant pressure exerted by the weight of the tube. If the tube were a horn, such as is generally used, the inability of the stylus to keep in adjustment with the groove of the record would be still greater. Another difficulty that would be caused by the weight of the tube bearing upon the sound-box would be the swaying of the carriage or truck, 55, upon the rail, 56. Without a horn, tube or other device attached to the sound-box or diaphragm casing, the audible reproduction of the sound would be practically impossible. 321

322 Second. The stylus, 29, is attached apparently to a pin projecting from the center of the diaphragm, but the stylus is without a fulcrum, as in Figures 3, 6 and 7 of Patent No. 534543. Therefore, although the stylus would be moved laterally by the lateral undulations of the record groove, the stylus thus moving would not cause the diaphragm to vibrate, and hence would not cause the sound to be reproduced.

Third. The movements of the stylus caused by the undulations of the record groove would be communicated to the truck, 55, suspended by wheels upon the rail, 56. Hence, as the stylus moves lat-
323 erally, the truck, 55, would move laterally, and the diaphragm would not vibrate and the sound would not be reproduced. If the stylus had a fulcrum or were otherwise connected with the diaphragm, so that it would, under proper conditions, cause the diaphragm to vibrate, and if the weight of the truck were made sufficiently large, there might be a vibration of the diaphragm, but in such case the weight of the truck would be so great as to interfere with its movement across the face of the record disc. No such arrangement, however, is shown or suggested, and even such an arrangement would be an impracticable one.

324 Fourth. Lost motion would occur where the pins pass through the wheels attached to the truck; in other words, the truck would vibrate and a proper reduction of sound would be impossible.

Fifth. The revolving disc would cause a swaying of the truck and the suspended sound-box with its attached stylus, by reason of which the stylus would constantly be forced out of adjustment with the groove of the sound record. As already stated, the weight of the tube, 33, would also have this effect.

Sixth. The pressure of the walls of the record groove upon the point of the stylus would tend to lift the inner wheel from the rail, and for this reason and for other reasons stated, the truck, 55, would constantly wabble. 325

Seventh. The height of the rail, 56, from the record, 54, is fixed or constant, and so is the length of the truck with the suspended diaphragm and stylus attached. No method is shown or described of causing the stylus to reach into the groove of the record. The depth of the record constantly varies, as is well known to all persons skilled in the art. If, therefore, the stylus does not reach down far enough, it will not enter the groove of the record, and if the stylus reaches down too far and comes in contact with the bottom of the record, the wheels of the truck, 55, would be lifted from the rail, 56, and the truck would fall. 326

Eighth. In the manufacture of disc talking machines, it has so far been impossible to construct a machine so that the record tablet or the plate supporting the record tablet will revolve in a plane perfectly horizontal. The revolving disc or tablet wabbles, or, in other words, the surface of the disc or tablet rises or falls, the rise or fall increasing toward the circumference. Because of this rise or fall of the revolving disc or tablet, either the stylus would leave the record groove or the bottom of the record groove would press upward against the point of the stylus and throw the truck off the rail, 56. In any case where the point of the stylus loses its adjustment with the record groove, the surface of the disc or tablet would subsequently strike against the point of the stylus and throw the truck off the rail. 327

Ninth. Record tablets are of varying thickness, and if the stylus would reach into the record groove of one record tablet with proper adjustment, it is

328 clear that it would not reach into another record groove upon a tablet or different thickness with proper adjustment. Therefore, either the truck would be thrown from the rail, or the point of the stylus would not reach the record groove.

Tenth. No method is shown or suggested of adjusting the stylus to the record groove or of keeping the stylus in the record groove, or of overcoming any of the difficulties pointed out, and although parts of a record might be reproduced, it would, in my opinion, clearly be impossible to reproduce a record of sound from start to finish.

329 Eleventh. In my opinion, the arrangement shown in Figure 10 is a mere laboratory experiment and not a practical or operative device, and the patent so far as this arrangement is concerned is a mere "paper patent."

My attention has been called to the article on Berliner's Gramophone published in the Electrical World for November 12, 1887. Mr. Berliner there suggests, as in No. 564586, at page 4, lines 123-126, that a "tolerably good reproduction may also be obtained by simply holding one end of a reed between the teeth and the other pointed end of the same in engagement with the record groove, while the disc is rotated." In the article in the Electrical
330 World, Mr. Berliner says:

> "This suggests the plan of mounting a reproducing diaphragm and stylus on a carriage moving on rails and permitting the point of the stylus not only to vibrate, but also to push the carriage across the revolving disc and thereby follow the volute of the sound record."

I have tried the method of reproducing sound by means of holding one end of a reed between the teeth, etc., as described, and the same is purely theo-

retical, no audible or reasonable or recognizable re- 331
production of sound being possible by such method, and in my opinion, the mounting of a reproducing diaphragm on a carriage moving on rails belongs to the category of reeds held at one end by the teeth. In his testimony in rebuttal in the suit of the Victor Talking Machine Company, *et al.*, vs. the American Graphophone Company, Mr. Berliner testified (Q4.), that his original apparatus embodying the construction shown in Figure 10 was lost. He further testified (Q6.) that the device covered by Claims 5 and 35 was first sold and put in public use in this country in 1894, by the United States Gramophone Company, seven years 332
after the application on November 7, 1887, for the Patent No. 564586, in which the arrangement shown in Figure 10 thereof is described. From an article published in the Electrical World for August 18, 1888, less than a year after Berliner filed his application on November 7, 1887, it appears that Suess' apparatus in this perfected form, the form in which it is used today, was then being used by Berliner, and I believe that the apparatus shown in Figure 10, above refered to, never was and never could have been more than a laboratory experiment.

Annexed hereto is a copy of the application filed 333
on behalf of the Talk-o-Phone Company for Letters Patent of the United States for improvements in talking machines. The first action of the Patent Office upon the application was had on March 8, 1906, with the result that the Patent Office had raised no objection of any kind to Claims 8, 9, 10 and 16, and only a formal objection to Claim 17, which claims cover the mechanical feed device of the machine now made and put upon the market by the Talk-o-Phone Company. Aside from its patentable features the machine described in the said annexed application and the talking

334 machine manufactured by the Talk-o-Phone Company in accordance therewith, one of which is herewith offered in evidence and marked Exhibit A, is made in accordance with English Letters Patent to Edison No. 1644, of 1878, and in accordance with numerous other patents for mechanical feed devices. Such mechanical feed devices operate on an entirely different principle from the Suess machine shown in Figure 3 of the Patent in suit No. 534543. Suess distinctly states in the Berliner-Suess Canadian and United States patents that he relies "upon this control of the stylus by the walls of the record groove for the movement of the stylus
335 across the face of the disc, there being no positive feeding mechanism for thus moving the stylus" (United States Patent 427279, page 1, lines 64-69); Canadian Patent No. 41901, page 3). In the Patent in suit No. 534543, at page 5, line 25, Berliner says, speaking of the same Suess device shown in Figure 3: "The rotating record groove will guide the stylus across the face of the tablet."

It appears from the annexed letters of Horace Pettit and the Victor Taking Machine Company that the complainant, the Victor Talking Machine Company, unwarrantably claims to the public that the Talk-o-Phone "mechanical feed" device is an infringement of Berliner Patent No. 534543, and
336 that the "mechanical feed" device can have no useful function to perform and is merely an attempt to evade said patent. These and all such statements I distinctly and emphatically deny. It is perfectly clear that the Talk-o-phone mechanical feed device and machine is manufactured according to well known principles of construction existing prior to November 7, 1887, and in accordance with the new patentable features described in the description and claims of the annexed application.

On March 13, 1906, at No. 90 West Broadway, in

the City of New York, I met Mr. Edward D. 337
Easton, President of the American Graphophone Company, and also Messrs. G. W. Lyle and R. F. Cromelin, officers of the same Company, and conversed with them with reference to talking machine matters. They urged upon me the advisability of the Talk-o-Phone Company taking a license under the Patent in suit No. 534543 from the Victor Talking Machine Company, complainant herein. They argued that it would be impossible for the Talk-o-Phone Company to prove the invalidity of that patent, notwithstanding the advice of our counsel, Mr. Hicks, to the contrary, and they stated that Mr. Pettit and Mr. Mauro were confident that 338
no one could now overthrow the patent. I spoke to them with reference to the Jones Record Patent recently held invalid by Judge HAZEL in suits brought by the American Graphophone Company, and they said that the Jones Patent had at least been the means of securing for them a license under the Berliner Patent in suit They seemed very anxious to have the Berliner Patent in suit now upheld, and as before stated, discouraged the idea that any one could or should further litigate that patent, and advocated strongly that the Talk-o-Phone Company take a license under the patent. I annex hereto copies of letters sent by the Victor 339
Talking Machine Company to the trade and by its counsel, Mr. Pettit, to customers of the Talk-o-Phone Company. In the letter of March 6, signed by Leon F. Douglass, Vice-President, this idea of taking a license under this expired and invalid patent is also advocated by the Victor Company.

The Talk-o-Phone Company is financially responsible. It has done and is doing a large business and owns and operates a large factory and plant at Toledo, Ohio, and has a branch office in the City of New York and in San Francisco, Cali-

340 fornia. Should the motion for preliminary injunction be denied the Talk-o-Phone Company would be amply able to respond in damages should the complainants eventually succeed at final hearing.

I have read the annexed affdavits of Edward F. Leeds (two) and of Albert L. Irish and the statements contained therein are true to the best of my knowledge, information and belief. I agree also with the reasoning and conclusions of said Leeds and Irish in matters relating to the use of records and machines. I herewith offer for the inspection of the Court a second sample Talk-o-Phone with
341 a mechanical feed device, marked Exhibit B, which the Talk-o-Phone Company is now manufacturing under my direction. An application for a patent on said Exhibit B has been filed in the United States on behalf of the Talk-o-Phone Company. As more fully set forth in the annexed affidavit of Mr. Irish the Talk-o-Phone Company has expended over Twenty Thousand dollars advertising its Talk-o-Phone with the mechanical feed device (Exhibits A & B) and the factory of the Talk-o Phone Company has been equipped at great expense to manufacture and sell the same on a large scale.

342 The Talk-o-Phones with the mechanical feed devices (Exhibits A and B) are recording as well as reproducing machines. They will record sound upon the usual tablets and will reproduce sound from the record of the same after recording. Thus it appears that the movement of the stylus across the face of the record in such Talk-o-Phones depends solely upon the mechanical feed device. Complainants' machines will not record but will only reproduce, thus showing that complainants' machines depend entirely upon the record groove

for the movement of the stylus across the face of the record. 343

HARRY ENSIGN.

Subscribed and sworn to before me this 5th day of April, 1906

[NOTARY'S SEAL.]

T. P. Dalton,
Notary Public,
Kings Co.

Certificate filed in New York Co.

CIRCUIT COURT OF THE UNITED STATES.

SOUTHERN DISTRICT OF NEW YORK. 344

VICTOR TALKING MACHINE COMPANY, *et al.*, vs. LEEDS & CATLIN COMPANY.	In Equity No. 8797.
VICTOR TALKING MACHINE COMPANY, *et al.*, vs. TALK-O-PHONE COMPANY.	In Equity No. 8859. 345

State and County of New York, ss.:

Edward F. Leeds, being duly sworn, says: I am President of Leeds & Catlin Company and I have been actively engaged in the talking machine business for over fifteen (15) years last past. I took an active part in the business of the North American Phonograph Company, which controlled

346 the phonograph and graphophone patents and manufactured sound records for that Company, and became familiar with the use and construction of recording and reproducing machines. About the year 1896 I became connected with Mr. Cleveland Walcutt in the talking machine business, and Mr. Walcutt and I for many years did business under the firm name of Walcutt & Leeds, manufacturing many thousand of sound records and various parts of talking machines for use in recording. Later I organized the Leeds & Catlin Company, which is now and has been since its organization actively engaged in the manufacture of
347 sound records, especially disc sound records.

The business of the Leeds & Catlin Company consists and has always consisted in the manufacture and sale of sound records, cylinder and disc sound records. The Leeds & Catlin Company has not been engaged in the manufacture of talking machines of any kind, except such recording machines as are used in the recording of sound records made in the manufacture by it. I have applied and obtained various Letters Patent for inventions made by me in the talking machine art, and I have studied and am familiar with the principal Letters Patent relating to this art. I have
348 made a very careful study of the theory and of the practice of recording and reproducing sound, and I am familiar with and I understand thoroughly the various machines and parts of machines used for such purposes.

I have read the annexed affidavits of Harry Ensign of the Talk-o-Phone Company, and of Louis Hicks. I have read the French, German, English and United States patents referred to in their said affidavits, and I agree with them:

First. That the reproducer shown in Figures 6 and 7 of the Patent in suit No. 534543, to Berliner,

and described in the specification thereof, embodies 349
the invention and only the invention embodied in German Letters Patent to Berliner No. 53622, of November 20, 1889. The reproducer shown, described and claimed in these two patents consists of a diaphragm mounted in a casing with a leaf spring extending over and across the diaphragm. The leaf spring is bent at about its center so that the surfaces of the two parts are at right angles the one to the other. One end of the leaf spring, the part parallel to the surface of the diaphragm, is fastened to the casing, while the other end carrying the reproducing stylus is free to vibrate. The reproducing stylus is attached to the free end of 350
the leaf spring in the same manner in each patent and the leaf spring is connected with the center of the diaphragm, and means are provided with which to regulate the tension between the diaphragm and the leaf spring. In each case the leaf spring is elastic in two directions at right angles to each other. Pieces of soft rubber in each case are used to dampen the individual vibrations of the leaf spring. The principle embodied in these reproducers of the said German and United States patent, the functions, the mode of operation and the construction of nearly every detail are substantially the same in one as in the other, and both 351
cover and embody the one invention.

Second. That the invention shown in figures 6 and 7 of the Patent in suit No. 534543 and described and claimed in the specification thereof is identical with the invention shown in Figures 3 and 4 of French Patent to Berliner No. 207090, of July 19, 1890, and described and claimed in the specification thereof. As the reproducer of the French Patent is identical in its construction, principle and mode of operation with the reproducer of the German Patent, it is unnecessary to

352 describe its details. It may be mentioned that the reproducer of the French Patent shows the perforated disc D (Figure 3) in the neck or tube attached to the diaphragm casing as in Figure 7 of the United States Patent (114), for the purpose of lessening the volume of the sound or rendering the sound more clear. In the German, French and United States patents the edge of the leaf spring comes in contact with the diaphragm casing at the point or place where the free end of the leaf spring passes over the rim of the diaphragm casing.

Third. That the invention shown in Figures 4 and 5 of the patent in suit and described and
353 claimed in the specification thereof is the same as in the invention shown in Figures 1 and 2 of said French Patent No. 207090 and described and claimed in the specification and claims thereof. The eccentricity of the lever shown in Figure 4 of the United States Patent is a mere difference in detail in no way affecting or qualifying the identity existing between the essential features of construction of the recorders of the two patents, and in the United States Patent the essential features of the recorder shown in Figures 4 and 5 are claimed without the eccentricity in Claims 6, 7, 8, 9, 10 and 16, for example, and in Claim 25. As appears
354 from Figure 4, the lever 61 may be adjusted so as not to be eccentric and so as to be along the line of a diameter. In the United States Patent (p. 3, lines 53-56), it is said of Figures 4 and 5, "to the end of the lever 61 is secured the recording stylus 62, by soldering or otherwise, with its plane at right angles to the plane of the lever as shown." In the French Patent it is said that the acoustic spring FH may be "composed either of two springs placed at right angles the one to the other as in Figures 1 and 2, or of a spring bent as in Figures 3 and 4." It is significant that in the United States and

French patents the acoustic springs of the recorders are composed of two springs placed at right angles the one to the other, while the acoustic springs of the reproducers are bent. It is clear that the two patents show, describe and claim one and the same invention. 355

Fourth. That the invention shown, described and claimed in United States Patent No. 564586 and in Claims 5 and 35 of No. 534543, the patent in suit, is also shown, described and claimed in English Patent No. 15232, of 1887; in German Patent No. 45048, of November 8, 1887, and in French Patent No. 186827 of November 8, 1887. This matter has been so fully considered in the affidavits of Messrs. Ensign and Hicks, with whose statements and conclusions I agree, that it is unnecessary to repeat the reasons for my opinion here. 356

Fifth. That the invention shown, described and claimed in Canadian Letters Patent No. 41901, of February 11, 1893, is identical with the invention shown in Figure 3 of the patent in suit, except in so far as Figure 3 of the patent in suit is modified by the use of the reproducer shown in Figures 6 and 7 of the patent in suit. The improved Berliner gramophone illustrated in the Electrical World of August 18, 1888, is obviously the gramophone of Werner Suess, and is substantially identical with the gramophone illustrated in the said Canadian Patent and in the corresponding United States Patent No. 427279, to Berliner as the Assignee of Suess. 357

I have carefully read Letters Patent to Berliner No. 564586, of July 28, 1896, applied for November 7, 1887, and have considered especially Figure 10 thereof and that part of the description (p. 4, lines 90-128) describing Figure 10. I have constructed an apparatus such as is shown in Figure 10, using,

however, a spring motor instead of a weight as the power with which to cause the tablet to rotate. With a stylus affixed to the diaphragm, as shown in Figure 10, it is impossible to obtain any practical or intelligible reproduction of sound. It is further impossible to attach a horn such as is shown in Figure 3 of the patent in suit to the diaphragm shown in the construction of Figure 10 of No. 564586, and to operate the apparatus so as to obtain a reproduction of the sound. It is, moreover, impossible to attach such a tube and flaring portion 33, shown in said Figure 10, to said diaphragm and to operate the apparatus so as to obtain a reproduction of sound. A stylus similar to the stylus 29 of Figure 10 and attached in like manner does not cause the truck 55 to move across the rail, but constantly bends, slips and leaves the record groove. As the record tablet never revolves in a plane perfectly horizontal, a truck suspended perpendicularly, as shown in Figure 10 does not keep the stylus in contact with the record groove. An apparatus such as shown in Figure 10, and such as I made and endeavored to operate immediately destroys the record by the slipping and scratching of the stylus. Difficulty was experienced in getting the truck 55 to maintain itself upon the rail 56, and in several instances the truck was thrown from the rail. As the tablet revolves the record groove striking the end of the stylus, such as 29, causes the truck to wabble. The depth of the grooves of disc sound records constantly varies and very likely this cause contributed to the indistinct reproduction obtained. Under favorable conditions, and using a reproducing stylus of today unlike that shown in Figure 10, and not using a horn, a reproduction of sound could be obtained, but from the apparatus shown in Figure 10, intelligible and continued reproduction of sound and the continued movement of the carriage along the

rail, and the keeping of the stylus point in the groove of the record was impossible. With the experience of today, many improvements could, of course, be suggested with reference to the construction shown in Figure 10, but I do not believe that even today a commercial and successful apparatus could be made according to that arrangement for the reason that I do not see how it would be possible to enable the diaphragm casing to carry the large horn used with all talking machines of today, and enable or permit the carriage to move across the rail 56. 361

The superintendent of my factory, Mr. Leo Moeller, assisted me in my experiments consisting in the construction and attempted operation of an apparatus such as is shown in Figure 10 of Patent No. 564586. Although I have been familiar with all talking machines put upon the market in the United States since the organization of the North American Phonograph Company in 1888, I never saw or heard of a talking machine operating according to the arrangement shown in Figure 10, except the one which, for the purpose of experiment, I constructed with my assistant, Mr. Moeller, in March, 1906. 362

EDWARD F. LEEDS.

Subscribed and sworn to before me this 5th day of April, 1906. 363

T. P. Dalton,
[NOTARY'S SEAL.] Notary Public,
Kings Co.

Certificate filed in New York Co.

364 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, vs. LEEDS & CATLIN COMPANY.	In Equity No. 8797.
VICTOR TALKING MACHINE COMPANY, *et al.*, vs. TALK-O-PHONE COMPANY.	In Equity No. 8859.

365

State and County of New York, ss.:

Leo Moeller, being duly sworn, says: I am superintendent of the factory of Leeds & Catlin Company and have been engaged in the talking machine business, especially in the manufacture of disc and other sound records, for the past four and one-half years. I have read the annexed affidavit of Mr. Edward F. Leeds and I conducted with him and
366 assisted him in the making of the experiment with an apparatus which we constructed in accordance with the arrangement shown in Figure 10 of United States Patent No. 564586 to Berliner, and in accordance with the description thereof found at page 4, lines 90-128. For the reasons stated by Mr. Leeds in his said affidavit the apparatus constructed and operated by us as aforesaid, in March, 1906, was not successful, and from my experience with talking machines I believe that an apparatus such as is shown in said Figure 10 belongs to the

class of laboratory experiments only. I have never 367
heard of such a machine ever put upon the market and I never saw one except the one which Mr. Leeds and I constructed and operated as aforesaid in March, 1906.

LEO MOELLER.

Subscribed and sworn to before me this 5th day of April, 1906.

T. P. Dalton,
Notary Public,
Kings Co.

[NOTARY'S SEAL.]

Certificate filed in New York County.

368

Defendant's Exhibit, Translation of Berliner French Patent No. 186827, of November 8, 1887.

Descriptive memorandum, annexed to patent of invention for fifteen years, taken November 8, 1887 by Mr. Emile Berliner, represented by M. Albert Cahen, Paris, Boulevard Saint Denis, No. 1, and which has been delivered to him by decree of the Minister of Commerce and of Industry under date of January 26, 1888, for "an apparatus for the recording and reproduction of sounds called gramophone."

369

PATENT NO. 186827.

This invention has reference to a novel method of, and apparatus for recording and reproducing all kinds of sounds, including spoken words, and is designed to overcome the defects inherent in that art, as now practised and in the apparatus used therefor.

(Note: The translation of the balance of this French Patent No. 186827 is identical with the complete specification of Letters Patent of Great Britain No. 15232, of 1887, to Emile Berliner, from line

370 9, page 1 thereof, beginning with the words, "By the ordinary method," and continuing down to the end thereof, including the claims, except that in said letters patent of Great Britain the claims are introduced by the following words: "Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is," while in said French letters patent the claims are introduced by the words "Summary; I claim as distinctive features of my invention"; and except that said letters patent of Great Britain close with the following words: "Dated this 8th day of November,
371 1887. Philip M. Justice, 55 and 56 Chancery Lane, London, Applicant's Agent," and said letters patent of France close with the words, "Paris, November 8, 1887, for Mr. Berliner. Signed; Albert Cahen." The 16 figures of the drawings of each of the two said patents are identical.)

The following certification appears upon said French letters patent:

(Seal; National Office of Industrial Property; National Conservatory of Arts and Trades.)

Paris, November, 6, 1905.
Certified as a correct copy.
Secretary General of
372 the National Office Of Industrial Property.
P. Noblesse.

[Note: See stipulation, *infra*, p 540, as to drawing of French Patent No. 186827.]

Defendant's Exhibit, Translation of Berliner French Patent No. 190602, of May 15, 1888.

Descriptive memorandum annexed to patent of

invention for fifteen years, taken May 15, 1888, by 373
Mr. Emile Berliner, represented by M. Albert Cahen, Paris, Boulevard Saint Denis, No. 1, and which has been delivered to him by decree of the Minister of Commerce and of Industry, under date of July 20, 1888, for "an improved process for the recording of sounds for their reproduction."

PATENT NO. 190602.

In a prior patent I have described a method of recording and reproducing spoken words and other sounds, etc.

(Note: The translation of the balance of this French Patent No. 190602 is identical with the com- 374
plete specification of Letters patent of Great Britain No. 7204, of 1888, to Emile Berliner, from line 7, page 1, thereof, beginning with the words, "and in connection therewith," and continuing down to the end thereof including the claims, except that in said letters patent of Great Britain the claims are introduced by the following words; —"having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is," while in said French letters patent the claims are introduced by the words, "Summary; Having thus completely described my invention, I
claim as the principal points characterizing it"; and 375
except that said letters patent of Great Britain close with the following words;—"Dated this 15th day of May, 1888. Philip M. Justice, 55 and 56 Chancery Lane, London, Applicant's Agent," and said letters patent of France close with the words, "Paris, May 15, 1888. For Mr. Berliner. Signed Albert Cahen.")

376 The following certification appears upon said French letters patent:

(Seal; National Office of Industrial Property; National Conservatory of Arts and Trades.)

Paris October 30, 1905. Certified as a correct copy.

Secretary General of the National Office Of Industrial Property.

P. Noblesse.

Defendant's Exhibit, Translation of Berliner French Patent No. 207090, of July 19, 1890.

377 Descriptive memorandum annexed to patent of invention for fifteen years taken July 19, 1890, by Mr. Berliner (Emile), represented by M. Armengand, Jr., Boulevard de Strasbourg, 23, Paris, and which has been delivered to him by decree of the Minister of Commerce, Industry and the Colonies under date of November 11, 1890, for "gramophone sound-boxes."

Patent No. 207090.

378 Figures 1 and 2 represent the recording sound-box.

Figures 3 and 4 represent the reproducing sound-box.

AA, casing as for telephones, microphones, etc.,

B, diaphragm.

C, acoustic tube.

D, diaphragm perforated to render the tone more clear.

E, small column.

FH, acoustic spring in combination, of elastic metal, caoutchouc, etc., composed either of 2 springs placed at right angles the one to the other,

as in Figures 1 and 2, or of a spring bent as in Figures 3 and 4. 379

GG rings of caoutchouc (they may also be of felt) to dampen the individual vibrations of the acoustic springs.

I, acoustic pin with or without threads, which transmits the vibrations of the diaphragm or of the acoustic spring from the one to the other.

KK, nuts serving to regulate, by making it ascend or descend, the acoustic spring, so that the diaphragm receives thus more or less pressure from above.

L, casing attached to FH and through which passes the acoustic pin which is there fixed by the screw, Q. 380

M, casing attached to the end of the spring FH, into which one inserts the needle O.

N, screw to hold the needle O.

P, screw to attach the acoustic spring FH to the casing, AA.

FUNCTION.

(See French Patent No. 186827, of November 8, 1887). Upon the surface upon which one is about to inscribe a sound-record (phonautographic inscription), one lowers the point of the spring FH until the latter forms the straight line xy. If, now, one speaks into the sound-box, the point of the spring will trace acoustic curves upon the surface. By engraving with a graving tool, with nitric acid, etc., (etching) one can then transform these curves into sound grooves. 381

In the reproducing sound-box 3, 4, the extremity of the acoustic spring H, carrying a ring of caoutchouc, G, presses against the casing of the sound-box. From the point of view of reproduction, this is more advantageous than if the spring were free, as in the recording sound-box 1, 2.

382 CLAIMS.

1. An apparatus for *recording* or *reproducing* sound-waves, composed of a diaphragm and of a vibrating spring or leaf placed transversely over the latter and of which one end is fixed while the free end is in contact with the surface recording the sound-waves.

2. An apparatus for *recording* or *reproducing* sound-waves, composed of a diaphragm, of an acoustic spring placed over the diaphragm and attached to it, a spring which is in part surrounded by gutta-percha, felt or by other like material, so
383 that this envelope dampens the individual vibrations of the acoustic spring.

3. An apparatus for *recording* sound-waves, composed of a diaphragm and of an acoustic spring connected with it, the free end of which is bent in its normal position but opens, so as to become straight, when it presses upon the tablet for the recording of the sound-waves.

4. An apparatus for *recording* sound-waves, composed of a diaphragm, of an acoustic spring placed over it and of a pin which connects the spring to the diaphragm in such manner that the tension between it and the accoustic spring
384 can be regulated.

5. An apparatus for *reproducing* sound-waves, composed of a diaphragm, of an acoustic spring placed over it and of a casing at the free end of the acoustic spring, into which casing one point of a needle is fixed in such manner as to be able to be taken out of it and replaced without difficulty.

6. An apparatus for *reproduction* of sound-waves, composed of a diaphragm, of an acoustic spring placed over it and of a casing at the middle of the spring, which casing is traversed by a separate pin,

establishing the connection with the diaphragm or spring. 385

7. An apparatus to *reproduce* sound-waves, composed of a diaphragm, of a casing for the diaphragm and of an acoustic spring placed over the diaphragm and connected to it, while its free end presses upon or against the casing.

Paris, July 19, 1890,
Representing Mr. Berliner,
Signed; Armengand, Jr.

(Seal; National Office of Industrial Property; National Conservatory of Arts and Trades.)

Paris, October 19, 1905, 386
Certified for correct copy,
Secretary General of the National Office of Industrial Property.
P. Noblesse.

(Seal; Ministry of Commerce, Industry, Postes and Telegraphs.)

Examined for the legalization of the signature
Of M. Noblesse, Secretary General of the National Office of Industrial Property. 387
Paris, October 19, 1905.
For the Minister of Commerce and Industry, and by authorization.
For the chief of the division of officers and of accounts.
The sub-chief of the bureau of officers.
L. Marcardit.

388 (Seal; Ministry of Foreign Affairs; French Republic.)

The Minister of Foreign Affairs certifies as genuine the signature of M. Marcardit.
Paris, October 19, 1905,
For the Minister,
For the Chief of the Bureau.
Charles Bavelier.

(Seal; Consulate General of the United States of America, Paris.)

389

U. S. Consul General, Paris, France, October 19, 1905,
The Seal of the Minister of Foreign Affairs and
The signature of M. Charles Bavelier are certified to be genuine.
Hanson C. Coxe,
Deputy Consulate-General of the United States of America,
Paris, France.

390

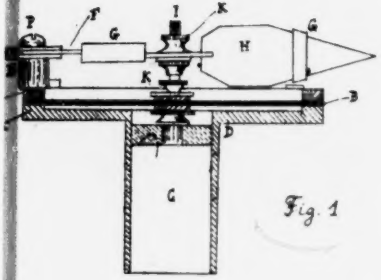


Fig. 1

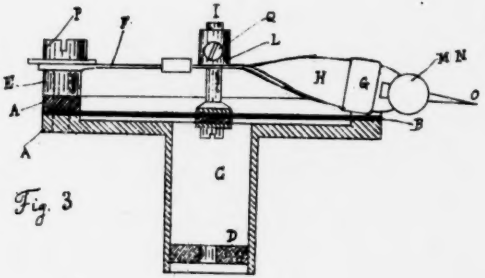


Fig. 3

Fig. 2

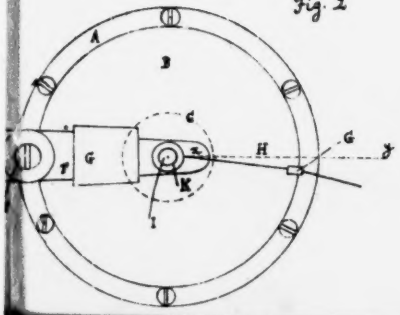
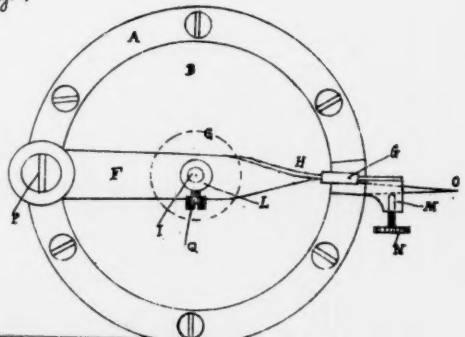


Fig. 4



394 **Defendant's Exhibit, Translation of Berliner German Patent No. 45048 of November 8, 1887.**

CERTIFICATE.

That the annexed copy of the specification agrees with that which to the holder of Patent 45048 with the patent deed has been issued, is certified with the remark, that the patent has been cancelled in the rolls.

Berlin, November 6, 1905.

[Seal; Imperial Patent Office] The President of the Imperial Patent Office.

Haup.

395

Imperial Patent Office. Letters Patent No. 45048.

Class 21: Electrical apparatus. Published November 2, 1888.

Emile Berliner of Washington (Columbia, U. S. A.)

Process and apparatus for the recording and reproducing of sounds. Patented in the German Empire from November 8, 1887.

The present invention has reference to a novel method of, and apparatus for the recording and

396 reproducing of sounds and spoken words.

By the apparatus for recording sounds and spoken words heretofore brought into use by way of experiment a stylus attached to a vibratory diaphragm is intended under the influence of the diaphragm to indent a travelling sheet of tin-foil or other suitable material or by cutting along into the same to make a groove. The operation of such an apparatus is not satisfactory, because the force of a diaphragm vibrating under the impact of the sound-waves is too weak to overcome the resistance of the tin-foil to a sufficient extent. Add to this,

that the said resistance increases with the depth of 397
the indenting or cutting and with the speed of the sheet of tin-foil, by reason of which the records obtained by the method hitherto employed cannot be correct. For this reason, loud sounds, for example, are less accurately recorded than weak ones, and the voice of a loud speaker recorded by the phonograph cannot be recognized. Moreover, if one gives to the stylus such a direction that the same touches the record surface only lightly, one obtains incorrect records; when in this case the diaphragm at times imparts a slight outward motion to the stylus, so that it does not touch the surface at all, the recording is entirely interrupted, es- 398
pecially if loud sounds are being recorded.

The present invention aims at a recording of sound-waves by a friction-resistance between the stylus and the recording surface which is constant throughout. The records obtained in this manner are then, by a special process, copied in a suitable, resisting material in order to be able to reproduce the sounds themselves.

The accompanying drawings illustrate two of the numerous forms in which an apparatus can be made according to the present invention.

Fig. 1 is a perspective view of one such apparatus.

Fig. 2 a perspective view of the recording dia- 399
phragm with the recording point or stylus.

Fig. 3 a perspective view of a part or the recording drum.

Fig. 4 a perspective view of the same part with the record surface applied.

Figs. 5, 6, and 7 show different views of a record surface.

Fig. 8 is a perspective view of another modified apparatus, in which the sounds are recorded upon a plain surface, while in the apparatus, shown in Figs. 1 to 7, the recording surface is cylindrical.

400 To illustrate further:

Figs. 9 and 10 a view of the appurtenant diaphragm with the stylus and a section through the middle of the first.

Fig. 11 a cross-section on the line x-x of Fig. 9.

Fig. 12 a vertical section through the middle of the recording disc.

Figs. 13 to 15 different details of construction of the mechanism and a centering device, and

Fig. 16 is a record-diaphragm.

According to the arrangements shown in Figs. 1 to 7, two standards H and J are mounted upon a base plate A, upon which is placed the shaft of the
401 drum G which is provided with side-flanges. At one place B the cylindrical surface of the drum G is broken by a gap to the edges of which a box K, extending into the interior of the drum, is fastened. Upon the cylinder surface a thin film *f'*, Figs. 3 and 4, of felt or other elastic material is placed, which is bent over the edges of the gap B and secured to the inner walls of the box K. This film serves as an elastic support for the recording surface. For the latter a strip made of paper, metal or other suitable substance is employed, the ends of which, in the manner shown in Fig. 7, are secured to two bars *c* and *d*, which after placing the strip upon the
402 elastic film *f'* of the drum, come to lie close together in the box K, Fig. 4, out of which they then project somewhat on the sides, in order by means of bolts *q* to fasten them together and thereby at the same time the strip to the drum. After the strip is fastened in the said manner, its surface is covered with a thin layer of a substance easy to remove by the action of the stylus. For this purpose lamp-black or smoke-black is used, which is deposited by placing a smoky flame under the strip and slowly turning the drum, until all parts of the strip are equally covered by the lamp-black. Such

a layer of lamp-black adheres well to the surface 403
of a solid body, but can, as is known, be very easily removed leaving a plainly visible line. This process is known and has already been used in the production of phonautographic records.

The diaphragm *m*, Fig. 2, is mounted in a frame *n*, with its plane at right angles to the axis of the drum G.

A post *o* is fixed to the centre of the diaphragm for a stylus *s*, which in the post *o* and in the second post *p* (on the frame *n*) is pivoted, while its end extending over the latter, Fig. 1, lightly touches the record surface of the drum; the stylus constitutes accordingly a lever, which (of sufficient 404
length) carries over the vibrations of the diaphragm to the record surface in a direction nearly parallel to the axis of the drum G. Near it the drum is slowly and uniformly rotated by means of a crank L or other like means, so that the free end of the stylus removes the lamp-black from the record surface in an undulating line, which is a true graphic representation of the sound, under the waves of which the diaphragm vibrates. Because of the extremely small friction, which in this the free end of the stylus has to overcome upon the record surface, the record of the undulating lines by loud and low sounds is alike correct, since the vibrations of the diaphragm, are not, as is the case in 405
all other sound recording apparatus, here modified by the reaction of a sensible resistance. A phonautographic record obtained in this way can be fixed by the appl ion of a thin layer of varnish of any kind which dries quickly and does not oblit erate the record. If the deposit of lampblack is thick enough upon the record surface, the same can be handled without care.

After the application of the varnish the strip is removed from the drum and can then be preserved any length of time without disfiguring the record.

406 For the purpose of reproduction the record is copied in solid resisting material, preferably metal, which is accomplished either by a mechanical process of engraving, or electrical deposition or photo-engraving. The last process is to be preferred, since by it an exact copy of the record in copper, nickel, etc., can be obtained, without affecting the original record. The copied record is now fixed at both ends to the bars *c d*, as shown in Fig. 7, and is placed upon the elastic support of the drum in the same manner as the original record strip. In this it is necessary to take care that both ends of the groove *y* meet exactly, which is easily attained. In
407 Fig. 1 is illustrated the apparatus with the engraved record upon the drum. The free end of the stylus pierces the undulating groove and the drum then uniformly revolves. Thus the end of the stylus is forced to follow the undulations of the groove *y*, while the other end of the stylus sets the diaphragm in vibrations corresponding with the undulations, which again reproduce the same sounds as those which produced the original record. In the phonograph and gramophone made hitherto, the stylus bearing upon the indented or engraved record is forced against the diaphragm only by the elevated portions of the record, while the opposite movement into the depressions of the
408 record is accomplished solely and only through the elastic force of the diaphragm, since the latter is always under tension. In the present apparatus, the free end of the stylus moves in a groove of uniform depth and is moved positively in both directions, that is to say without dependence in one direction upon the elasticity of the diaphragm, and this sure movement of the one end of the stylus has as a consequence a forced movement of the diaphragm as sure.

This new process of recording and reproducing sound, does not, moreover, necessarily require the

use of a diaphragm, but there can also be used in 409
its stead any sonorous body (for example a tuning fork) in like combination with the stylus. Also the record surface need not be placed upon a drum, but it can be supported in any suitable manner upon a solid support of any description, which is moved uniformly past the stylus.

Also the lamp-black can be replaced by any other substance, which adheres well to the solid supporting body and is removed from the same with a small force.

In the form of the new apparatus shown in Figs. 8 to 16 the fundamental principles of the gramophone first described are retained and only cer- 410
tain changes of construction are undertaken which offer improvements in the process. The cylindrical surface of the gramophone first described has the disadvantage, that a copying of the record by the process of photo-engraving requires first a straightening of the former and then a laying of the straight engraved record plate upon the drum for the purpose of the reproduction of the sound.

This manipulation, attended with many details, is avoided in the following apparatus, in which the record of the sounds is produced upon the under surface of a flat plate which lies horizontally. At the same time, this arrangement offers also the advantage that the material removed by the stylus 411
falls away from the plate and leaves the undulatory groove very sharply defined, while in the apparatus described the material removed to the side by the stylus accumulates thickly in the adjacent grooves.

In Figs. 8 to 16, 1 is the platform of the apparatus, 2 a metal plate which is provided with a guiding rib 3 and is fastened upon the plate 1, and which supports the standards 4, 4′. Of the latter, one (4) is provided with a nut bearing 5, and the other (4′) with a smooth bearing (5′), Fig. 13, for

412 the shaft 6, which to the middle (or beyond) is provided with screw-threads, while on the remaining smooth portion extending to the right for a considerable distance it is provided with a groove 16. Between the standards 4 and 4′ is a movable support 7, which is movable upon the prismatical rib 3. This carries the shaft 6, the smooth part of which passing through a perforation of the movable support and through collars 8, 8 is securely connected with the movable support. The support 7 also carries the screw bearing 11, Fig. 12, of a bevel gear 9, which rests directly upon the screwed on head of the movable support and is provided with a flange 10, which serves as a support for the plate
413 13 (composed, with respect to the following transfer by the process of photo-engraving, of transparent material and preferably of glass free from blisters) and which is connected with the same by screws or the like. Finally, a bevel gear 14 fixed upon the shaft 6 engages bevel gear 9, by which the rotation of the shaft 6 is transmitted to the wheel 9 and (through this) to the glass disc 13, while the resulting longitudinal movement of the shaft 6 causes at the same time a similar movement of the movable support 7 and through this means a continual movement of the center of the glass disc 13.

414 Over the part (Fig. 13) of the shaft 6 provided with a longitudinal groove 16 is passed a sleeve 17 provided with a suitable spring or with a guide-pin 18, which sleeve on one side rests in the bearing 5′ of the standard 4′ and to which on the other side, by means of a wedge or the like, is fixed a compound gear 19. The latter is composed of a pinion 20, which meshes with a large bevel gear 22 mounted upon the shaft 23, and of a bevel gear 21 which meshes with the small bevel gear 24. Upon the shaft of the latter are secured the fans 25, which, rotating with great speed, serve as a regulator.

A weight 26, which is suspended by cords or the like 27, which are wound about shaft 23, is designed to set the latter in rotation and thereby the whole apparatus in action. 415

By this arrangement a fixed stylus pressing against the under surface of the rotating and at the same time advancing glass disc describes a spiral line, the pitch of which depends upon the degree of the advancing motion of the center of the disc and is determined by the pitch of the screw-thread of the shaft 6 and the rapidity of rotation of the disc itself.

In order to make the line, which the stylus describes upon the glass disc, visible and useful for further application, it is recommended in the present case to apply not lampblack but a layer of ink or color, which during the recording is sufficiently viscous neither to drop off nor to run. One obtains then, with extremely little friction of the stylus upon the glass disc, an extraordinarily sharply drawn line, which one can use in the following process of photo-engraving directly as a negative, when one exposes the metal to be engraved directly through the glass disc during the influence of the light at the described lines. 416

The recording stylus is in the present apparatus connected with the diaphragm 30, Fig. 9, in substantially the same manner as in that first described. The diaphragm itself (which, moreover, as in the first case, can also be replaced by any sonorous body) is fastened between two urceolate plates 31, Fig 10. A tube, 32, of rigid material, which is inserted into one of the two plates, serves as a connection with a flexible tube provided with a mouthpiece, 34 (Fig. 8), which can serve as well for a speaking tube as for an ear tube. The diaphragm itself caries at its centre a knob to which one end of the stylus is made fast by means of a soft rubber tube, 41, which is simply flattened and 417

418 forced into a slot of the knob. The stylus, 29, consisting preferably of a flat strip of phosphor bronze, pointed at its extreme end and suitably curved, is provided at about the middle of its length with a hole, Fig 11, through which a pin 42, formed at one end of a metal block, 43, and inserted into the central bore of a second metal block, 44, passes, which on each side of the stylus carries a soft rubber washer. The metal blocks, 43 and 44, finally rest on the points of the adjusting screws, 46, which accordingly constitute the pivot of the stylus. Moreover, the free part of the stylus rests upon a piece of rubber tubing 48, or the
419 like and consists itself of two pieces fastened to each other by a piece of rubber tubing 49, or the like. Because of this arrangement the free end of stylus is moved by the vibration of the diaphragm to the right and left of its position of rest, nearly parallel with the surface of the disc 13. The diaphragm is brought to the apparatus by a support 36, Fig. 10, which embraces the tubular support 32, and which is movable horizontally in a bearing 37, movable vertically in the standard 38. The process of recording and reproducing sounds by means of this apparatus appears from the foregoing description. The laying on of
420 the ink or color upon the glass disc is preferably done in the following manner; the under surface of the same is carefully polished and dried and then by means of a camel-hair brush is provided with a thin film of oil, while the disc rotates with moderate speed. Hereupon a smoky flame is held under the glass disc, in order to blacken it with lamp-black, which is absorbed entirely by the previously deposited oil and forms with the same a dense, uniform coating of very small thickness.

This coating which adheres very well to the glass disc, offers no perceptible resistance at all to the

point of the stylus. The disc is now ready to re- 421
ceive the phonautogram, and it is moved to the position shown in Fig. 8, with the point of the stylus near the outer edge. The point is then so adjusted that it exerts only a very slight pressure against the disc, which barely suffices to penetrate the coat of ink, whereupon the hitherto supported weight 26 is set free so that it sets the apparatus in motion. Hereupon the stylus describes as already stated, a spiral line upon the disc. If now, during the progress of the disc, sound waves are directed against the diaphragm, through the mouthpiece 34 and the tubes 33 and 32, the stylus will be vibrated to the right and left of the spiral line, and an undulatory 422
line, Fig 16, of even depth at all points will be described, which records with entire accuracy the sounds taken up by the diaphragm.

When the stylus comes near flange 10, the adjusting collar 8, upon shaft 6, is loosened and the latter is permitted still to rotate somewhat further, whereby disc 13 rotates without progress of its middle point and the stylus describes a circle 51, Fig. 16, which later facilitates the centering of the transferred record and is, therefore, called the centering circle.

The glass disc is then removed from the apparatus and the record inscribed in the coating of the 423
same is fixed by a thin coat of varnish, so that it may afterwards be handled without special care. Hereupon the copy of the record is produced in copper or other metal by means of the process of photo-engraving, wherein, as already stated, the original record is used as a negative. In the photo-engraved copy the sound-record appears, as an undulatory line of even depth, also the centering circle 51, by means of which, first of all, the center of the copy is determined by geometrical construction. After holes for the flange screws 12, Fig. 12, have been made on this at equal distances from the

424 determined center and diametrically opposite each other, and also a small hole in the middle itself, one can with certainty apply the metallic record to flange 10 of bevel gear 9. In order to increase the precision of this application, a suitable cylindrical block 52, Fig. 15, is placed in the upper part of the hole in which is found the head of screw 11, which serves as a pin for bevel gear 9. This block, which is called a centering block, has a fine axial hole 53, which corresponds exactly with the axis of wheel 9.

If now the photo-engraved copy of the record is placed upon flange 10, and the screw pins 12 passed
425 through the corresponding holes, a fine pin, say a sewing needle, is passed through the centering holes of the disc and of the centering block 52, and the nuts 50, are screwed upon the screws 12. Then the stylus is so adjusted, that the point of the same is in engagement with the outer end of the record groove and the weight 26 is allowed to descend. The stylus is then forced positively to follow the undulations of the record and to set the diaphragm in vibration, so that the same sounds, which produced the original record, are plainly heard again through the ear tube.

In place of making the copy of the original record in metal, one can also make it of sealing-wax,
426 for which one first makes a negative copy in metal and presses this upon a cake of softened sealing wax. The negative record can then be preserved for an indefinite time and be used at times as a stamp for the multiplication of the positive record in a cheap way.

Patent claims:

1. The inscribing of phonautographic records on a coating of semi-fluid ink or color spread upon a solid support, which is produced by first applying a coating of oil or fat to the support and then

spreading a thin layer of lamp-black upon the coating of oil. 427

2. An apparatus adopted for the use of the coating characterized under 1 for the reception of phonautographic records, characterized by:

a) A rotating drum G, which at one part of its circumference is broken by a recess B resembling a furrow and is provided with an elastic covering (of felt or the like), over which a strip of paper or the like is drawn and stretched by placing in the recess B two prismatic bars, *cd*, which are fastened to the ends of the strip, and by joining them to each other by the pin (*q*); 428

b) A two armed lever *s* fastened at the center of the diaphragm (or of the sonorous body) and attached pivotally to the casing (or at the edge) of the same, the free arm of which, pointed at the end, stands at right angles to the axis of the drum and approaches so far toward the same that its point strips off the covering of the paper strip in the direction of a line winding off as a straight or spiral line.

3. In the apparatus characterized under 2, the substitution for the paper strip carrying the record of a strip of flexible, but otherwise resisting material, in which the said record is copied by electrolysis or in other suitable manner, for the purpose of the reproduction of the recorded sounds and tones. 429

4. An apparatus adapted for the use of the coating characterized under 1 for the reception of phonautographic records, characterized by:

a) A horizontal disc (13), provided on its under surface with the said coating and made of resisting material, which, by means of a concentric driving wheel 9 connected with it, the vertical ro-

430 tating axis of which rests securely in a bearing (7) movable on a prismatic guide, stands in engagement with a shaft 16, which during its rotation moves in the direction of its length by automatic screwing and thereby takes with it the bearing (7) by means of adjusting collars or the like;

b) A stylus (29) consisting of elastic stiff parts joined with each other and in like manner as under 2b), yet elastically, joined with the diaphragm (or the sonorous body), the point of which removes the coating of the disc in the direction of the recorded line—and, after the loosening of the adjusting collars connecting the bearing (7) with the shaft 16,
431 in a circle.

5. For the purpose of making an exact mounting of a disc constructed for the reproduction of the tones and sounds as a substitute for the disc (13) of the apparatus characterized under 4, the process of providing the latter disc in two places with holes and producing in the covering of the same in the manner characterized under 4b), a circle, which by photo-engraving is visible in the reproducing disc in like manner as the holes.

Hereto is added 1 sheet of drawing.

432

[Note: The 16 figures of the drawing of the above German patent are identical with the 16 figures of the drawing of English Patent No. 15232 of 1887, to Emile Berliner.] (See stipulation, *infra*, p. 540, as to drawing of German Patent No. 45048.)

Defendant's Exhibit, Translation of Berliner German Patent No. 47099, of May 16, 1888. 433

CERTIFICATE.

That the annexed copy of the specification agrees with that which to the holder of Patent 47099 with the patent deed has been issued, is certified with the remark, that the patent has been cancelled in the rolls.

Berlin, November 6, 1905.

[Seal; Imperial Patent Office] The President of the Imperial Patent Office.

Haup.

434 Imperial Patent Office. Letters Patent No. 47099. Class 21: Electrical apparatus and machines. Published April 26, 1889.

Emile Berliner of Washington (Columbia, U. S. A.)

Process for the recording of sounds. Addition to Patent No. 45048, of November 8, 1887. Patented in the German Empire from May 16, 1888. Longest duration: November 7, 1902.

In order to be able to transfer the sound-recording-line, inscribed by the apparatus shown in the chief patent upon a non-resisting layer, directly 435 to the resisting support of this coating itself, one can make use of the etching process. In this process, when one heretofore made use of the process "for transferring inscriptions by etching to a resisting material" one employed a fluid etching ground layer of wax, which one made fluid for this purpose through heat. An etching ground made in this manner possesses, however, even if it is put on in a very thin layer, so great a toughness and clings by reason thereof so tenaciously to the surface to be etched, that it requires a not inconsid-

436 erable effort to get out of such an etching ground suitable lines for the etching.

Such an etching ground is, therefore, not useful for the present purpose, in which it acts for the production of a record without the use of force, and the use of the etching process for the production out of this ground of a record capable of being reproduced in resisting material was not heretofore possible.

The present invention relates now to the process for the making of an etching ground, which does not show this difficulty, but offers the possibility of the production of record inscriptions with the
437 same sharpness as the lamp-black mentioned in the chief patent.

The new process rests:

1. Upon the discovery, that wax, paraffine, etc., poured out in a dissolved condition and hardened through the evaporation of the solvent, shows a very small cohesion and as small adhesion to the surface covered with it.

2. Upon the discovery, that the slight contamination of the etching ground through the taking up of dust fibre from the air loses its troublesome effect, appearing in the making of the record inscrip-
438 tions, if one immediately before the recording of the sounds puts this etching ground in a moist condition by pouring upon it concentrated alcohol.

One obtains a good etching ground, if one dissolves beeswax at a moderately high temperature in benzine so far that one obtains thereby a saturated solution. This is then filtered and care is taken thereby to free the same as much as possible from the dust present in the air. This solution is spread uniformly upon the surface to be etched which is previously smoothly polished, cleaned and dried, and then the solvent (benzine) is permitted

to evaporate which it does within one or two min- 439
utes.

The result of this process is an exceedingly delicate film adhering to the surface to be etched, which offers to the recording stylus of the recording apparatus described in the chief patent no perceptible mechanical resistance; indeed, the delicacy of this film is so great that it is very perceptibly disturbed by stroking it with a camel's hair brush, so that it is then no longer useful for its intended purpose.

In order to lessen somewhat this exceedingly great sensitiveness of the film and at the same time to increase its resistance to the etching agents sub- 440
sequently employed, it is recommended to coat this film with still a second, produced in like manner, which, nevertheless, does not perceptibly increase the mechanical resistance of the etching ground to the recording stylus.

It has been mentioned, that it is necessary carefully to protect the material of the etching ground up to the time of its hardening from the dust of the air; but experience has taught that it is almost impossible to maintain this absolutely free from fine filamentary particles of dust. Although these almost unavoidable fine particles of dust are so fine that even with the most careful examination they escape the naked eye, still the same cause 441
trouble in the production of the record.

But if the etching ground is not perfectly free from dust fibres, the same will adhere to the recording stylus and be by it dragged through the newly formed grooves, whereby the latter obtain uneven edges which seriously impair the accuracy of the record.

Numerous experiments led to the discovery, that this difficulty is entirely overcome, if the etching ground during the recording is put in a moist con-

442 dition by a previous moistening with concentrated alcohol. The alcohol evaporates, it is true, very quickly, but still not quickly enough to disappear entirely before the record has been recorded, and this record shows now no unevenness of any kind; the lines are, moreover, as sharp and defined as if they had been made by a graver, and the point of the recording apparatus appears as clean as if the filamentary particles had entirely disappeared.

The principal of this phenomenon is not wholly cleared up; it may be that the fine particles of dust are hereby forced against the walls of the record grooves and by these held fast. Beside this
443 result the alcohol also still acts as a kind of lubricator for diminishing the friction of the recording stylus.

Since the etching ground made in the manner described is exceedingly thin and entirely colorless, so the record engraved in the same is almost invisible to the naked eye; but since it is desirable to examine the record before the etching, it is, therefor, recommended to color the etching ground before the recording of the record. This can be accomplished by exposing the etching ground to the cold smoke of a weak smoking flame, for example, of burning camphor, so that a very light deposit of lamp-black is made upon the etching
444 ground and the record inscriptions are afterwards visible as pale lines upon a gray ground.

Care must be taken in this blackening, that the etching ground is not held near to the flame, so that the same does not begin to melt, since otherwise the peculiar consistency of the same is entirely changed.

The prepared phonautographic support can be preserved indefinitely and is at all times in useful condition.

The recording of the sound record is accomplished in exactly the same manner, as when the

record supports are covered only with the half fluid ink, not useful as an etching ground, mentioned in the chief patent. 445

For the etching of the phonautographic record into the resisting support of the etching ground, one can, indeed, use the usual acids common for such purpose as nitric, hydrochloric, etc., for metals and fluoric acid or the fumes thereof for glass; here, however, it should be considered that in the etching hydrogen gas becoming free collects along the record lines and, especially on the edges of the same, forms a bar against further action of the acid.

In the ordinary process of etching, moreover, one can render this development of gas harmless by a brushing from time to time of the surface. But such a brushing of the delicate etching ground used in the present case would be impracticable, since no brush material exists that is sufficiently delicate not to injure the etching ground. For this reason it is advisable so to choose the etching agent that the hydrogen gas at the moment of becoming free is absorbed by the material to be etched. If the record support consists, for example, of zinc, and one uses chromic acid as an etching agent, no accumulation of gas bubbles takes place. 446

The records inscribed in such manner in resisting material can, without further preparation, be used directly for the reproduction of the recorded sounds. Also one can make of the same by electrolysis as great a number of copies as one pleases; in this case it is, however, necessary, first to polish the etched record, before one puts the record support into the electrical bath. Such a polishing one can obtain through a slight pressing of a pointed burnishing tool into the record-groove, while one for this support holds with one hand the burnishing tool in the groove and with the other sets the record support in rotation. In this manner the tool is guided by the record groove itself, while the 447

448 slight granular structure of the same is polished in a few moments without the characteristic of the groove suffering any damage whatever.

Instead of a special burnishing tool, the reproducing stylus of the recording apparatus can álso itself be used, the point of which usually consists of a hard metal, as iridium or the like. In this case, after one or two uses of the record for reproduction, the burnishing is effected.

Patent-claim:

In an apparatus for the recording and reproducing of sounds by the method characterized in
449 the chief patent No. 45,048, the substitution for the half-fluid ink, characterized in claim 1 of that patent, of an etching ground which consists of a saturated solution of wax, paraffine (or like substances slightly sensitive to acids) in a solvent readily evaporated, as benzine, and the moistening of the same immediately before its use, as a record surface, with strong alcohol, for the purpose of lessening as much as possible the resistance of the etching ground against the recording stylus, as well as of making possible the inscribing of a very sharp record and thereby the direct production of a record of resisting material by etching for the reproduction of the sounds.
450

Defendant's Exhibit, Translation of Berliner German Patent No. 53622, of November 20, 1889.

CERTIFICATE.

That the annexed copy of the specification agrees with that which to the holder of patent 53,622 with the patent deed has been issued, is certified with

the remark, that the patent has been cancelled in 451
the rolls.

Berlin, November 6, 1905,

(Seal; Imperial Patent Office.)

The President
of the Imperial Patent Office.
Haup.

Imperial Patent Office. Letters Patent No. 53,622. Class 42: Instruments.

Published September 17, 1890.

Emile Berliner of Washington (Columbia, U. S. A.)

Improvement upon the process and apparatus 452
protected by Patent 45048, for the recording and reproducing of sounds.

Second addition to Patent No. 45048 of November 8, 1887. Patented in the German Empire from November 20, 1899. Longest duration: November 7, 1902.

In the chief patent No. 45048, as in the first patent of addition No. 47099, there is described an apparatus for the recording of sounds, in which a stylus, set in vibration by a diaphragm in like direction as the diaphragm itself, traces upon a drum or plate revolving before the stylus and provided 453
with a coating according to the process protected in the said patent, light undulatory lines, which can then be transferred for the reproduction of the sound by the like stylus and the like diaphragm, so that neither for the recording nor for the reproducing of the sound is an operation of engraving or other destruction of the means serving for the recording necessary.

The present invention relates to an instrument in the part of the apparatus performing the reproduction and is that shown in the drawing in Figure

454 1 in a front view and in figure 2 in a vertical cross-section.

Upon the casing *cc'*, which holds between its parts the diaphragm *b* of mica, metal, etc., in such manner that the diaphragm can vibrate freely, is a spring *aa'* consisting of flat steel with its one end fastened, while the other end carrying the stylus can vibrate freely.

This flat spring can be bent somewhere about the middle at 90°, so that the part fastened to the casing extends with its flat part parallel to the diaphragm, while the free end of the spring stands with its principal face perpendicular to the dia-
455 phragm. The connection between the spring and the diaphragm is by means of a pin *m* which can be connected with the spring by means of an adjusting screw *f* passing through a metal block *e*, which on its part is made fast to the spring *aa'* and carries the perforation for the metal pin *m*. There is upon the diaphragm, for strengthening the place where the perforation is for the passage of the pin *m*, a small metal plate *o* made fast on one side, while on the other side a nut *n* is screwed upon the metal pin *m* which at this place is provided with screw threads. By an insertion of the adjusting screw *f* with the metal block *e* at one or another point of the metal pin *m*, the tension, which exists between
456 the spring and the diaphragm, can be regulated and at a suitable strength found by trial this tension is permanently fixed.

The reproducing stylus proper is not applied to the spring *aa'*, but consists of a special needle or spike *k*, which in a metal block *h* is held fast by an adjusting screw *i* or screwed in, which metal block is then in turn made fast to the spring *aa'*. This arrangement makes it possible easily to take out the spike, change it and replace it by another.

With the casing *cc'* carrying the diaphragm

there is connected the tube *d*, which leads to the horn for the further reception of the sound. In order to obtain a dampening of the function of the spring, a ring of rubber *r* is inserted by means of the screw *g* by which the spring is made fast to the frame cc′, while the freely vibrating end of the spring is surrounded by a ring of rubber *s*. 457

The method of operation of the apparatus remains the same as that shown in the chief patent and the first patent of addition.

Patent-claim.

The replacing of the two armed lever (s) protected by claim 2b of the chief patent No. 45048, and of the recording stylus (29) protected by claim 4b of the same, by a spring (aa′) carrying the stylus for the reproduction of the sound, which with the one end is made fast to the casing (cc′) enclosing the diaphragm, while the other end of the same can vibrate freely, so that the vibrations communicated to the latter are carried over by means of the pin (m) connecting the spring and the diaphragm at right angles to the surface of the diaphragm. 458

Annexed is 1 sheet of drawing.

459

Kopie der Patentschrift 53622.

Emile Berliner in Washington. (Columbia, V. St. A.)

Neuerung an dem durch das Patent 45048 geschützten Verfahren und Apparat für das Registriren und Wiederhervorbringen von Tönen.

Fig. 1.

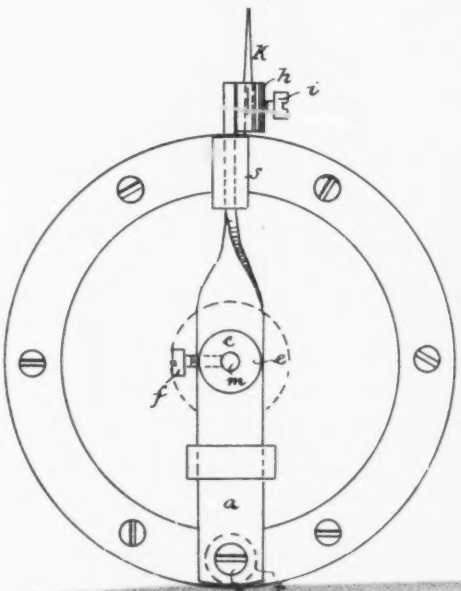
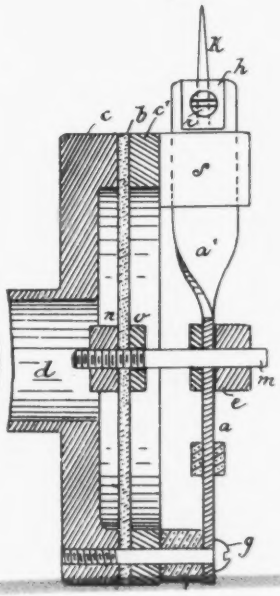


Fig. 2.



DOMINION OF CANADA.

PATENT (cut) OFFICE.

Certified that the annexed is a true copy of a Patent registered in the Patent Office under number 41901 granted to Emile Berliner and bearing date the Eleventh day of Feb., 1893, for "Improvements in Gramophones" with true copies of the specification and drawings remaining on record in this office, duplicate copies of which were attached to the Patent above mentioned.

(Seal.) Inventions Patent Office, Department of Agriculture Canada Bureau des Brevets D'Invention.)

AS WITNESS the seal of the Patent Office hereto affixed at the City of Ottawa in the Dominion of Canada this Nineteenth day of October. In the year of our Lord on thousand nine hundred and five.

GEO. F. O'HALLORAN.

DOMINION OF CANADA.

(cut) 41901.

To all to whom these presents shall come

Whereas Emile Berliner, Physicist, Assignee of Werner Suess, Mechanician, both of Washington, District of Columbia, United States of America, has petitioned the Commissioner of Patents, praying for the grant of a Patent for alleged new and useful Improvements in Gramophones, The said Werner Suess, having assigned to the said Emile Berliner, the right of obtaining the Patent and the exclusive property in and to the said invention, a description of which invention is contained in the specification, of which a duplicate is hereunto attached, and made an essential part hereof, and has elected his domicile at Ottawa, Ontario,

466 in Canada, and has also complied with the other requirements of the Patent Act Chap. 61, Revised statutes of Canada, and the Acts amending the same.

Now Therefore the present Patent grants to the said

Emile Berliner,

his executors, administrators, legal representatives and assigns, for the period of Eighteen Years from the date of these presents, the exclusive right, privilege and liberty of making, constructing and using, and vending to others to be used, in the Dominion of Canada, the said invention, subject
467 nevertheless to adjudication before any Court of competent jurisdiction.

Provided, that the grant hereby made is subject to the conditions contained in the Acts aforesaid.

The partial fee required for the term of six years having been paid to the Commissioner of Patents, this Patent shall cease at the end of six years from date, unless at, or before the expiration of the said term, the holder thereof pay the fee required for the further term or terms as provided by law.

In Testimony Whereof, I have hereunto set my hand and caused the Seal
468 of the Patent Office to be hereunto affixed, at the City of
[L. S.] Ottawa, in the Dominion of Canada, this Eleventh day of February in the year of our Lord one thousand eight hundred and ninety-three.

Countersigned Sigd. A. R. Angers.
Commissioner of Patents.

Sigd. R. Pope.
Deputy Commissioner of Patents.

Specification.

469

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, WERNER SUESS, of the City of Washington, in the District of Columbia, U. S. A., mechanician, having invented certain new and useful improvements in Gramophones, I do hereby declare that the following is a full, clear and exact description of the same.

Reference being made to the accompanying drawing, in which Fig. 1 is a perspective view of one form of reproducer shown in the supporting frame, with a sound-conveying tube, with the diaphragm and stylus, in operative relation to the record disc.

470

Fig. 2 is a perspective view of the pivotal bearing of the frame, with parts removed and broken away.

Fig. 3 s a plain view of another form of supporting frame for the reproducer, by which the stylus is caused to travel in a straight line across the record tablet; and Fig. 4 is an end view of the same with the counterweight removed.

Like numerals of reference indicate like parts all throughout the drawings.

My invention has reference to improvements in the reproducing apparatus adapted for use in the method of recording and reproducing sounds here- 471
tofore invented and published by Emile Berliner. The whole apparatus used for the practice of the said method has been called the "Gramophone," and in this class of sound-recording and reproducing apparatus, the record is ordinarily produced on the face of a rotating disc as a volute band consisting of a sinuous or undulating groove of even depth. In the production of this record, a recording stylus is made to travel over the face of the rotating disc from the outer circumference toward the center in a straight radial path. The repro-

472 duction of the recorded sounds is effected by giving to a reproducing stylus vibratory movement by and in accordance with the sinuosities of the record groove, and these vibratory movements being transmitted to a diaphragm, vibrations of the latter give rise to sounds which are copies of the sounds originally uttered against the recording apparatus.

With the view of intensifying the sound emitted by the reproducer, and more especially of directing the same to the listener or listeners, I use a funnel-shaped tube, on the contracted end of which the reproducing stylus and diaphragm are mounted, while the open flaring end of the tube is directed toward the listener or listeners. This flaring
473 sound-conveyer thus becoming an intregal part of the reproducer, must have all the mass movements of the stylus and diaphragm; and being of considerable weight, it must be so supported and balanced that the recording stylus will bear with light but sufficient pressure upon the record tablet.

The best results are obtained if the reproducing stylus is made to travel in a straight radial line across the face of the record tablet, substantially in the manner in which the recording stylus has traveled in producing the record.

The main features of my present invention, therefore, have reference to the means for supporting
474 and counterbalancing the sound-conveying tube, with its attached diaphragm and reproducing stylus, and for making the path of the stylus across the face of the record disc as nearly as practicable a straight radial line.

The stylus engaging with its point the record groove, is controlled by the walls of the latter, and as will be hereinafter more fully shown, I rely upon this control of the stylus by the walls of the record groove for the movement of the stylus across the face of the disc, there being no positive feeding mechanism for thus moving the stylus.

Referring now to Fig. 1, there is shown a base plate 1, which may be secured by screws or otherwise, to any suitable support, such for instance, as a table. Erected on this base plate is a standard 2, on one edge of which are laterally projecting eyes 3, forming guides in which turns a vertical shaft or pivot 4. This shaft is stepped at the lower end in a bearing 5, in the base plate, and at the upper end, has secured to or formed on it, a head 6, which, as shown more clearly in Fig. 2, consists of a flat plate, to the center of which the shaft 4, is attached. 475

This head 6, serves as a support for a frame 7, consisting of an end piece 8, two parallel side pieces 9, secured at one end to the end piece by screws, as shown, or otherwise, and a rod 10, joining the other ends of the side pieces 9. Mounted in the side pieces 9, are pointed screws 11, projecting through nuts therein, and entering oppositely arranged seats (not shown) in the ends of the head 6, and forming a pivotal bearing for the frame 7, around which it may turn in a vertical plane at right angles to the axis of the shaft 4. 476

It will now be understood that the frame 7, may be moved in any direction, the shaft 4 and pivot screws 10, constituting a universal joint for the same. The rod 10, carries one end of an arm 12, secured rigidly thereon by a jam nut 13, which clamps the said arm firmly against a flange 14, on the rod, which latter is screw-threaded, as shown, for the reception of the nut 13. 477

The arm 12 is stiffened by longitudinal side ribs 15, and terminates at the free end in a head 16, on one side of which is secured a diaphragm holder 17, carrying a diaphragm 18; and on the other side of the head there is secured a flaring socket 19, communicating at its reduced end with a chamber (not shown) at the rear of the diaphragm.

478 Attached to the diaphragm is a stylus 20, mounted for lateral vibration and together with the said diaphragm, forming a sound reproducer. The construction of the stylus and the mounting therefor, form no part of the present invention, and are, therefore, not specifically described herein. The point of the stylus rests normally in the record produced on the face of a disk-tablet 21, which is mounted for rotation upon a disc carried by a vertical shaft 22, similar to the shaft 4, before described.

As shown in Fig. 1, the shaft 22, has at its upper end a thumb-nut 23, by means of which the tablet is
479 clamped thereon, and the said shaft is passed through eyes 24 (one only being shown) on a standard 25, and stepped in a bearing 26, in a base plate 27, on which the standard is erected.

The lower end of the standard is extended laterally on the plate 27, as shown at 28, and terminates in an upturned end 29, carrying at its upper end and below the level of the tablet, a bearing 30, for a horizontal shaft 31, which latter is provided with a crank 32, at the outer end, and a friction-wheel 33, at the inner end, which wheel engages the under side of the tablet supporting disc, which is not visible in the drawing.

It will now be understood that when the shaft
480 31, is rotated by means of the crank 32, the friction-wheel 33, engaging the tablet support will cause the latter to rotate and carry successive portions of the record under the stylus to reproduce the sounds, in a manner described in the aforesaid publications.

The mechanism for supporting and rotating the tablet may be of any suitable construction and entirely different from that shown, such construction being by no means an essential feature of my invention.

Secured to the end piece 8, of the frame 7, is a rod or arm 33′, extending in a direction opposite to that of the arm 12, and carries a weight or block 35; this weight may be adjusted upon rod 33′, and clamped in any desired position on a thumb-screw 36. 481

Attached to a short stem erected on the end piece 8, and over the shaft 4, is a semi-circular bracket 37, on which rests the funnel-shaped sound conveyer 38, the smaller end of which enters the socket 19. It will be readily understood that the sound conveyer supported in the manner described, together with the diaphragm and stylus, carried in the mounting attached to the arm 12, may be moved laterally around the axis of the pivot shaft 4, and vertically around the axis of the frame 7. By reason of these two movements, the stylus may be made to approach toward or recede from the axis of the rotating tablet, and in this manner traverse every portion of the surface of the said tablet; or it may be swung aside and entirely removed therefrom. 482

The operation of an apparatus so constructed, is as follows:

The tablet 21, containing a sound record in the form of a convolute sinuous or wavy groove, produced in the manner set forth in the aforesaid publications, is mounted on the supporting disc carried by the shaft or spindle 22. The weight 35 is adjusted to nearly counterbalance the arm 12, and parts carried thereby, so that the stylus rests lightly, but with sufficient pressure on the tablet with its point in the record groove. 483

The tablet is now rotated and the sinuous groove thereon vibrates the stylus, which in turn vibrates the diaphragm in accordance therewith, and thus produces sound waves, which latter are directed toward the listener by the sound conveyer 38. As the rotation of the tablet is continued, the convolu-

484 tions of the record groove will cause the stylus to be slowly drawn across the tablet, turning the entire support of the reproducing apparatus on its pivot bearing, the said stylus moving along a slightly curved path over the said tablet.

When placing a tablet in position, or on removing it therefrom. it is necessary to move the reproducer out of operative relation thereto; and for this purpose, the supporting frame is swung on the horizontal and vertical pivots to some position away from the tablet, when it may be lowered until a .....leg 38′, which depends from the arm 12, rests upon the
485 table on which the apparatus is secured.

It will be understood that the counter-weight may be adjusted to cause the stylus to bear with any desired degree of pressure on the tablet.

Referring now more particularly to Figs. 3 and 4, there is shown a standard or post 39, which is fixed to a table or other support, and terminates at the upper end in a yoke 40, having two upturned parallel ends 41, each carrying an inwardly projecting pointed screw 42, extending through a suitable nut formed therein. The pointed ends of these screws enter suitable seats on opposite sides of a plate 43, and constitute a horizontal pivotal bearing on which the said plate may be rocked. The
486 plate 43, has an arm 44, formed on it and extending centrally from one side, at right angles to its axis, and it also has another arm 33′, similar to that shown in Figs. 1 and 2, extending in a direction opposite to the arm 44, being on the other side of the axis of the plate.

The arm 33′ carries a sliding weight 35, similar in construction to that before described, and in a like manner serving as a counterweight.

Above the center of the plate 43, there is a semicircular bracket consisting of two curved branching arms 45, arising from a block 46. Through

this block there is a perforation for a pivot-bolt 47, which extends downwardly through the plate 43, and there receives a nut 48, by means of which the bolt is secured to the said plate, and the head of the bolt engages the upper face of the said block 46. This bolt 47, also passes through a washer 49, resting directly on the upper surface of the plate 43, and through eyes formed in the ends of links 50, the said ends being interposed between the lower end of the block 46, and the washer 49, thus it will be seen that the bolt forms a vertical pivot around which the bracket 45, 46, and the links 50, may move, and also secures them to the said plate. 487

The outer ends of the links 50, are pivoted to opposing corners of an articulated frame 51, composed of links 52, of equal length, connected together at the ends by pivot pins 53, 54, 55, and 56, respectively, the pins 54 and 55, also connecting the links 50, to the frame at the points before mentioned. 488

The pin 56, also pivotally connects one end of a link 57, to the corresponding corner of the frame 51, the other end of the said link being pivoted to the outer end of the arm 44.

The frame 51, together with the links 50, and 57, constitutes a well known mechanical movement, by which a curvilinear movement is converted into a rectilinear movement, provided the various links have the proper relative lengths; which is supposed to be the case in this instance, and, therefore, no detailed description of the operation thereof is deemed necessary. 489

In the apparatus shown in Figs. 3 and 4, the arm 12, is replaced by the link movement or system, and in this case the stylus and diaphragm will be mounted on the outer or free end of the said link system, namely at 53, and the sound conveyer 38, indicated by dotted lines in Fig. 4, will rest on friction rollers 57, mounted in bearings formed in cut

490 away or recessed portions 58, of the bracket arms 45.

In the operation of this apparatus, the counterweight 35, is adjusted in the manner before described, and the entire reproducer mechanism is moved to a position in which the stylus rests on the tablet, at the beginning of the record to be produced. Such position is indicated in Fig. 3, by the upper series of dotted lines, from which it will be seen that the frame 51, is of greater length than breadth.

As the record tablet is rotated, the volute record groove acting on the stylus, slowly draws it across the face of the tablet, as before explained, and turns
491 the entire reproducing apparatus on its vertical axis or pivot 47. As the apparatus approaches the position coinciding with the vertical plane of the arm 44, of the plate 43, the link 57, moving through an arc of shorter radius than that of the links 50, tends to force the frame 51, outward, which tendency is resisted by the said links 50, and the consequent action of these two opposing forces is to shorten the length and increase the breadth of the said frame 51, until it assumes the square form shown in full lines, Fig. 3. As the movement of the stylus is continued beyond the central plane of the arm 44, the frame 51, will be again lengthened,
492 as indicated by the lower series of dotted lines.

It will be understood that the length of the frame 51, decreases as the latter approaches a central position, and increases as it recedes therefrom, and in accordance with this change of shape of the said frame, its outer end (and the stylus thereon) will be carried to a constantly increasing distance from the pivot or axis of the apparatus, and the resultant of this constant longitudinal movement of the outer end of the frame, while the apparatus moves in an arc around its pivot, is to move the said end in a straight line.

When the reproducer stylus is moved over the record tablet in the manner stated, its path will coincide with the radius of such tablet, and the point of the said reproducer stylus will be at all times in the same relation to the record grooves as was the recorder stylus in producing such record. 493

In this operation, the sound conveyer must participate in the movement of the stylus toward and from the pivot 47, and it will, therefore, slide upon the arms 45, of the supporting bracket, and with a view of reducing the friction, the rollers 57, are provided.

CLAIMS.

Having now fully described my invention, I claim and desire to secure by letters patent: 494

1. In an apparatus for reproducing sounds from a rotating record tablet, a reproducing stylus mounted on a swinging lever system and having a rectilinear path over the record tablet substantially as described.

2. In an apparatus for reproducing sounds from a rotating record tablet having a record in the shape of a spiral groove, a reproducing stylus and diaphragm mounted on a swinging lever system and having a radial path over the record tablet, substantially as described. 495

3. In an apparatus for reproducing sounds the combination of a disc having a record of sounds in the shape of an undulatory, spiral groove upon its surface and rotating about its center, with a reproducing stylus guided by the record groove and mounted on a swinging lever system, so as to have a radial path over the record tablet, substantially as described.

4. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer

496 mechanism, consisting of a sound conveyer, and a diaphragm and stylus at one end of the said conveyer, of a system of links supporting the stylus end of the reproducer and proportioned and arranged as described for moving the stylus in a straight path across the record surface, substantially as described.

5. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism consisting of a sound conveying tube and a diaphragm and stylus mounted at one end of the tube, of a freely swinging supporting frame for the said reproducer mechanism, substantially as
497 described.

6. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism consisting of a sound conveying tube and a diaphragm and stylus mounted at one end of the tube, of a freely swinging supporting frame for the said reproducer mechanism, and a weight adjustable on the said frame to counterbalance the reproducer mechanism, substantially as described.

7. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism consisting of a sound conveyer, and
498 a diaphragm and stylus mounted at one end thereof, of a supporting frame for the said reproducer, loosely pivoted to swing freely both laterally and vertically, substantially as described.

8. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism, consisting of a sound conveyer, and a diaphragm and stylus mounted at one end thereof, of a supporting frame for the said reproducer, loosely pivoted to swing freely both laterally and vertically, and an adjustable counter-weight on the said frame, for determining the pressure of the

stylus on the record tablet, substantially as described. 499

9. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism, consisting of a sound conveyer, and a diaphragm and stylus at one end of the said conveyer, of a counter-weighted, pivoted frame for supporting the reproducer mechanism and provided with a system of laterally movable pivoted links connected at one end to the said reproducer mechanism, and at the other to a portion of the supporting frame fixed against lateral movement, substantially as described.

500

10. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism, consisting of a sound conveyer, and a diaphragm and stylus at one end of the said conveyer, of a system of links supporting the stylus end of the reproducer and constructed as described, for moving the stylus in a straight path across the record surface, and a pivoted bracket on which the sound conveyer rests, provided with anti-friction rollers on which the said conveyer travels longitudinally to participate in the movement of the stylus end of the reproducer, substantially as described.

501

11. In an apparatus for reproducing sounds from a rotating record-tablet, a reproducing stylus mounted to have a free movement over the surface of the record tablet, substantially as described.

12. In an apparatus for reproducing sounds from a rotating record tablet, a reproducing stylus mounted on a swinging lever system for carrying the stylus freely over the surface of the record tablet, substantially as described.

13. In an apparatus for reproducing sounds from

502 a rotating record tablet, a reproducing stylus mounted on a lever system permitting universal movement of the stylus, substantially as described.

In testimony whereof, I have hereunto signed my name in the presence of two subscribing witnesses, at Washington, District of Columbia, April 13th, 1891.

Werner Suess,
(signature of Inventor.)

Two Witnesses:
Joseph Lyons,
Frank T. Chapman.

This is the original specification referred to in the affidavit of Werner Suess hereunto annexed.

503 Sworn before me at Washington, District of Columbia, this thirteenth day of April, A. D. 1891.

Charles S. Drury,
Notary Public.

[SEAL.]

[Note: For stipulation as to drawing of Canadian Patent No. 41901 see *infra*, p. 541.]

DOMINION OF CANADA.

PATENT (cut) OFFICE.

CERTIFIED TO BE a true and correct copy of Assignment No. 20889 From W. Suess to E. Berliner. Recorded January 28th, 1893. Affecting Patent No. 41901.

504

(Seal; Inventions; Patent Office. Department of Agriculture. (cut) CANADA. Bureau des Brevets D'Invention.)

AS WITNESS the seal of the Patent Office hereto affixed at the City of Ottawa, in the Dominion of Canada this 27th day of October in the year of our Lord one thousand nine hundred and five.

Geo. F. O'Halloran,
Deputy Commissioner of Patents.

Patent Office 505
May 5
1891
CANADA.

Assignment Before Issue.

In consideration is the sum of One Hundred Dollars ($100) to me paid by Emile Berliner, of the city of Washington, District of Columbia, U. S. A., I do hereby sell and assign to the said Emile Berliner all my right, title and interest in and to my invention, for new and useful Improvements in Gramophones, as fully set forth and described in the specification which I have signed preparatory to obtaining a patent in Canada, and I do hereby 506
authorize and request the Commissioner of Patents to issue the said patent to the said Emile Berliner, in accordance with this assignment.

Witness my hand and seal, this Thirteenth day of April, 1891, at the city of Washington, District of Columbia.

(sgd) Werner Suess.

Witnesses:
Joseph Lyons.
Fannie Wise.

DOMINION OF CANADA.

PATENT (cut) OFFICE. 507

Certified to be true and correct copies of the Petition, Oath, Powers of Attorney, Receipt, Correspondence and Wrapper remaining of record in this office relating to application Serial No. 137454 filed on the 5th day of May, 1891, by Emile Berliner as assignee of Werner Suess, for "Gramophones," and which which matured to a Patent on the 11th day of February, 1893, and numbered 41901, and that the said patent expired on the 11th day of Febru-

508 ary, 1899, by reason of the non-payment of the fee for the second term of six years.

(Seal; Inventions. Patent Office. Department of Agriculture (cut) CANADA, Bureau des Brevets D'Invention.)

AS WITNESS the seal of the Patent Office hereto affixed at the City of Ottawa in the Dominion of Canada this 28th day of October in the year of our Lord one thousand nine hundred and five.

Geo. F. O'Halloran,
Deputy Commissioner of Patents.

509 O. K.

Patent Office,
May 5, 1891.

CANADA.

PETITION.

TO THE COMMISSIONER OF PATENTS:
OTTAWA,

The petition of Emile Berliner, of the City of Washington, District of Columbia, in the United States of America, physicist, showeth:

510

That Werner Suess, of the City of Washington, District of Columbia, in the United States of America, mechanician, has invented new and useful improvements in Gramophones, not known or used by others before his invention thereof, and not being in public use or on sale, with the consent or allowance of the said Werner Suess, as such inventor, for more than one year previous to this application for a patent therefor in Canada.

That your petitioner, by an assignment, bearing date the 13th day of April. 1891, acquired the right

of obtaining a patent from—Werner Suess afore- 511
said, for the said invention.

Your petitioner, therefore, prays that a patent may be granted to him as the assignee of the said Werner Suess, for the said invention, as set forth in the specification in duplicate relating thereto, and for the purpose of the Patent Act your petitioner elects his domicile in the City of Ottawa, Province of Ontario.

Emile Berliner.

Washington, D. C., April 13th, 1891.

OATH.

City of Washington, } 512
District of Columbia, }

I, Werner Suess, Mechanician, of Washington in the District of Columbia, make oath and say that I verily believe that I am the inventor of the new and useful improvements in "Gramophones" described and claimed in the annexed specification in duplicate relating thereto, and for which Emile Berliner solicit a patent by his petition dated April 13th, 1891.

And I further say that the several allegations contained in said petition are respectively true and correct.

(Signed) Werner Suess. 513

Sworn before me at Washington, in the District of Columbia, this Thirteenth day of April, 1891.

(Signed) Charles S. Drury,
Notary Public.

POWER OF ATTORNEY.

To the Commissioner of Patents, Ottawa:

The undersigned, Werner Suess, of the City of Washington, District of Columbia, United States of America, mechanician, hereby appoints Joseph

514 Lyons of Washington, District of Columbia, U. S. A., his attorney with full power of substitution and revocation, to prosecute an application for patent in Canada, for improvements in Gramophones, filed May 5, 1891, No. 56823; to sign the drawings, to receive the patent and to transact all business in the Patent Office connected therewith.

Signed at Washington, D. C., this 23rd day of January, 1893.

Werner Suess.

In the presence of:
E. Berliner.

R. C. M.
515 K. J. M.

POWER OF ATTORNEY.

To the Commissioner of Patents, Ottawa:

The undersigned, Emile Berliner, of the city of Washington, in the District of Columbia, United States of America, physicist, hereby appoints Joseph Lyons, of the city of Washington, District of Columbia, United States of America, his attorney, with full power of substitution and revocation, to prosecute an application for new and useful improvements in "Gramophones"; to sign the drawings, to receive the patent, and to transact all
516 business in the Patent Office connected therewith.

Signed at Washington, D. C., this Thirtieth day of April, 1891.

Emile Berliner.

In the presence of:
Werner Suess.

Patent Office, 517
May 5, 1891
CANADA.

PATENT OFFICE, CANADA.

Received from Messrs. Berliner & Suess,
$22. No. 21325
Patent and Ass't Fee. W. J. Lynch,
Cashier.

Cashier's Office,
May 5, 1891.

JOSEPH LYONS,
MECHANICAL AND ELECTRICAL EXPERT 518
SOLICITOR OF PATENTS,
EQUITABLE BUILDING, 1003 F Street, N. W.,
Cable Address, "Jolly".

Washington, D. C., May 2, 1891.

Hon Commissioner of Patents,
Ottawa, Canada.

Sir:—

With even mail, under separate cover, Please receive the application papers of Werner Suess, for Improvements in "Gramophones", and enclosed herein please find an assignement of the inyention from Werner Suess to Emile Berliner, together 519
with a postal money-order for Twenty-two dollars ($22) in payment of the application fee of Twenty dollars ($20) and the fee for recording the assignment, of Two dollars ($2).

Very respectfully,

Joseph Lyons,
Attorney for Emile Berliner.

520 Joseph Lyons,
Mechanical and Electrical Expert,
Solicitor of Patents,
Equitable Building, 1003 F Street, N. W.
Cable Address, "Jolly".

Washington, D. C., January 24, 1893.

Hon. Commissioner of Patents,
Ottawa, Canada.

Dear Sir:—

In the matter of the application of Werner Suess, No. 56,823, Filed May 5th, 1891, for Im-
521 provements in Gramophones, I herewith transmit the Power of Attorney of the inventor called for by communication from your Office, of January 5th, 1893.

Early action in this case is now respectfully solicited.

Your obedient servant,
Joseph Lyons,
Attorney for Suess & Berliner.

522

ENDORSED. 523

T. M. C. PATENT No. 41901. COST OF COPIES. PATENT & SPECIFICATION, $ SPECIFICATION, DRAWING, PETITION, OATH.

No. 56823.
DEPARTMENT OF AGRICULTURE,

PATENT BRANCH,

Washington, D. C.

May 2/5 1891

E. Berliner assignee of W. Suess per 524
J. Lyons, 1003 F St., N. W.

APPLICATION FOR PATENT FOR Gramophones.

$22.00 Model dispensed with (C. B. D.) 4/1/93.

Action Ackn. by Cir: 1 Receipt mailed. Model & Power of Atty. called for May 8/91.

Action Continued.

4/1/93 Patent may issue
M. Pope 525
Deputy Comr. of Patents
Power of Attorney again called for
Jany. 5/93. Power of Atty. rec'd
Jany. 24/26/93. Ackn'd Jany. 27/93.
Asst. 20889 Rec'd. Jany. 28/93.
Patent dated Feby. 11/93.
" mld. " 18/93 with Asst.

526 Translation of

THE LAW OF FRANCE.

(From Patent Laws of the World, Collected, Edited and Indexed. By Alfred Carpmael, Solicitor, etc., and Edward Carpmael, B. A. Patent Agent, etc.) Second edition, Revised. London. William Clowes and Sons, Limited, 27 Fleet St. 1889")

FRANCE. LAW OF THE 5TH OF JULY, 1844.

Chapter I.

GENERAL PROVISIONS.

527 Art. I. Every new discovery or invention, in all departments of industry, confers upon its author, under the conditions and for the time hereinafter mentioned, the exclusive right of working for his own profit the said discovery or invention.

This right is established by deeds delivered by the Government, under the name of Patents of Invention.

Art. 2. The following shall, etc.,

Art. 3. The following are not patentable, etc.,

Art. 4. The duration of patents shall be five, ten or fifteen years.

528

Every patent shall be subject to the payment of a tax fixed as follows:

Five hundred francs for a Patent of five years:
One thousand francs for a patent of ten years.
Fifteen hundred francs for a patent of fifteen years.

This tax shall be paid by annuities of one hundred francs under penalty of forfeiture if the patentee allows any year to elapse without paying the tax.

Chapter II. 529

FORMALITIES RESPECTING THE DELIVERY OF PATENTS.

Section I.

Applications for Patents.

Art. 5.

Any person who shall wish to obtain a Patent of Invention must deposit under a sealed cover, at the office of the Secretary of the Prefecture in the department in which he is domiciled, or in any other department, on electing domicile there,—

530

1. His petition to the Minister of Agriculture and Commerce;

2. A specification of the discovery, invention, or application forming the subject of the patent applied for;

3. The drawings or specimens necessary for the comprehension of the specification; and,

4. A memorandum of the documents deposited.

Art. 6.

The application must be limited to a single principal object, with the details that constitute it, and the applications which shall be indicated. 531

It must mention the duration which the applicants wish to assign to their Patent within the limits fixed by Article 4, and must contain neither restrictions, conditions, nor reservations.

It must set forth a title containing a short and precise designation of the object of the invention.

The specification must not be written in a foreign language. It must be without alterations, or interlineations. Words erased must be counted and verified; the pages and references being initialed. It

532 must not contain any denomination of weights or measures other than those inserted in the table annexed to the law of the 4th July, 1837.

The drawings must be made in ink and to a metrical scale.

A duplicate of the specification and drawings must be added to the petition.

All documents must be signed by the applicant or by his attorney, whose power remains annexed to the petition.

Art. 7.

No deposit can be received except on the production of a receipt proving the payment of the sum
533 of one hundred francs on account of the patent tax.

An entry made without charge by the General Secretary of the Prefecture on a special register, and signed by the applicant, shall prove every deposit, indicating the day and hour when the documents were delivered.

A copy of the said entry shall be delivered to the depositor on paying the cost of the stamp.

Art. 8.

The term of the Patent will run from the day of the deposit being made according to Article 5.

534 Section II.

Delivery of Patents.

Art. 9.

Immediately after the registration of the petitions, and within five days from the date of the deposit, the Prefects are to transmit the documents under the seal of the inventor, to the Minister of Agriculture and Commerce, adding thereto a certified copy of the entry of the deposit, the receipt proving the payment of the tax, and, if there be one the power of attorney mentioned in Article 6.

Art. 10. 535

On the arrival of the documents at the Ministry of Agriculture and Commerce they shall be opened, the petitions registered, and the patents delivered in the order in which the said petitions have been received.

Translation of

THE LAW OF GERMANY.

(From Patent Laws of the World, Collected, Edited and Indexed. By Alfred Carpmael, Solicitor, etc., and Edward Carpmael, B. A. Patent Agent, etc.) Second edition, Revised. London. William Clowes and Sons, Limited, 27 Fleet St. 1889.") 536

Germany. LAW OF THE 1ST JULY, 1877.

FIRST SECTION.

Patent Rights.

§1.

Patents are granted for new inventions which can be turned to account in trade.

The following are excepted:—

1. Inventions the use of which would be incompatible with the laws or public morals: 537

2. Inventions of articles of food (for nourishment or luxuries), of medicines and of substances produced by chemical process, so far as the invention does not relate to a definite method of producing such articles.

§7.

The duration of a patent is 15 years; the term commences with the day following the day of appli-

538 cation. If an invention is an improvement upon another invention patented in favour of the applicant, the latter may apply for a patent of addition, which terminates with the patent for the original invention.

THIRD SECTION.

Proceedings in Patent-matters.

§20.

The application for the grant of a patent for an invention must be made in writing to the Patent Office. For each invention a separate application is required. The application must contain the peti-
539 tion for the grant of a patent, and must point out with precision the object sought to be patented. In a separate document the invention must be described in such a manner that its practicability plainly appears to skilled persons. The necessary drawings, figures, representations, models and samples must be supplied at the same time.

The Patent Office will issue regulations respecting the other requisites of the application.

Up to the time of publication of the application, alterations in the description are permitted. With the application a fee of 20 marks (£1) must be paid for the cost of the proceeding.

540 §22.

If the Patent Office finds the application in due form, and that there is no objection to the granting of a patent, it will order the application to be published. From the date of publication, the subject of the application will provisionally have the protection of a patent in favour of the petitioner (§§1 and 5).

If the Patent Office is of opinion that, according to §§1 and 2, the invention is not patentable, the application will be rejected.

§24.

After expiration of eight weeks from the day of publication (§23) the Patent Office will decide as to the granting of the patent. Until that date objections against the granting can be lodged with the Patent Office. They must be made in writing, giving the grounds, which can only be the assertion that the invention is not new, or that it comes under §3, part 2.

Before deciding, the Patent Office may summon and hear the interested parties; it may also cause the grounds of objection to be examined by persons skilled in any branch of technical science, and otherwise take steps for elucidating the matter.

§26.

If the grant of the patent is decided upon, the Patent Office will cause a notice to that effect to be published in the Reichsanzeiger, and issue a document to the patentee.

If the patent is refused, this will also be publicly notified. Upon the refusal, the provisional protection will be held void.

THE PATENT ACT OF CANADA.

HER Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:

SHORT TITLE.

1. This Act may be cited as The Patent Act, 35 V., c. 26, s. 53.

APPLICATION FOR PATENTS.

10. Every inventor shall, before a patent can be obtained, make oath, or, when entitled by law to make an affirmation instead of an oath, shall make an affirmation, that he verily believes that he is the inventor of the invention for which the patent

544 is asked, and that the several allegations in the petition contained are respectively true and correct.

2. In the event of the inventor being dead, such oath or affirmation shall be made by the applicant, and shall state that he verily believes that the person whose assignee or legal representative he is, was the inventor of the invention for which the patent is solicited, and that the several allegations in the petition contained are respectively true and correct.

3. Such oath or affirmation may be made before
545 a minister plenipotentiary, *charge d'affaires*, consul, vice-consul, or consular agent, a judge of any court, a notary public, a justice of the peace, or the mayor of any city, borough or town, or a commissioner for taking affidavits, having authority or jurisdiction within the place where the oath may be administered. 55-56 V., c. 24, s. 2.

11. The applicant for a patent shall, for the purposes of this Act, elect his domicile at some known and specified place in Canada, and shall mention the same in his petition for a patent. 35 V., c. 26, s. 12.

12. The applicant shall, in his petition for a pat-
546 ent, insert the title or name of the invention, and shall, with the petition, send in a specification in duplicate of the invention, and an additional or third copy of the claim or claims. 56 V., c. 34, s. 1.

13. The specification shall correctly and fully describe the mode or modes of operating the invention, as contemplated by the inventor, and shall state clearly and distinctly the contrivances and things which he claims as new and for the use of which he claims an exclusive property and privilege.

2. Such specification shall bear the name of the 547
place where, and the date when it is made, and shall be signed by the inventor, if he is alive, and if not, by the applicant, and by two witnesses to such signature of the inventor or applicant.

3. In the case of a machine, the specification shall fully explain the principle and the several modes in which it is intended to apply and work out the same.

4. In the case of a machine, or in any other case in which the invention admits of illustration by means of drawings, the applicant shall also, with his application, send in drawings in duplicate, 548
showing clearly all parts of the invention, and each drawing shall bear the signature of the inventor, if he is alive, and if not, of the applicant, or of the attorney of such inventor or applicant, and shall have written references corresponding with the specification; but the commissioner may require further drawings or dispense with any of them, as he sees fit.

CONFLICTING APPLICATIONS.

19. In case of conflicting applications for any patent, the same shall be submitted to the arbitration of three skilled persons, two of whom shall be chosen by the applicants, one by each, and the third 549
of whom shall be chosen by the commissioner or by the deputy commissioner or by the person appointed to perform the duty of that officer; and the decision or award of such arbitrators, or of any two of them, delivered to the commissioner in writing, and subscribed by them or any two of them, shall be final, as far as concerns the granting of the patent.

* * * * * * *

named by the commissioner, which shall be paid by the applicants jointly. 35 V., c. 26, s. 43, part.

550 GRANT AND DURATION OF PATENTS.

20. Every patent granted under this Act shall contain the title or name of the invention, with a reference to the specification, and shall grant to the patentee and his legal representatives, for the term therein mentioned, from the granting of the same, the exclusive right, privilege and liberty of making, constructing and using, and vending to others to be used, the said invention, subject to adjudication in respect thereof before any court of competent jurisdiction.

2. In cases of joint applications, the patents shall be granted in the names of all the applicants. 35
551 V., c. 26, s. 10, part, and s. 16; 36 V., c. 44, s. 5.

21. Every patent shall be issued under the seal of the Patent Office and the signature of the commissioner or of the deputy commissioner, and when duly registered shall be good, and shall avail the grantee and his legal representatives for the term mentioned in the patent. 56 V., c. 34, s. 2.

2. The commissioner may require that any patent before it is signed by the commissioner or by any other member of the Queen's Privy Council for Canada, acting for him, and before the seal hereinbefore mentioned is affixed to it, shall be examined
552 by the Minister of Justice; and if such examination is so required, the Minister of Justice shall, accordingly, examine it, and if he finds it conformable to law, he shall certify accordingly, and such patent may then be signed, and the seal affixed thereto. 35 V., c. 26, s. 6, part, and s. 18.

22. The term limited for the duration of every patent of invention issued by the Patent Office shall be eighteen years; but at the time of the application therefor it shall be at the option of the applicant to pay the full fee required for the term of six

years, or the partial fee required for the term of 553
twelve years. 55-56 V., c. 24, s. 5.

2. If a partial fee only is paid, the proportion of the fee paid shall be stated in the patent, and the patent shall, notwithstanding anything therein or in this Act contained, cease at the end of the term for which the partial fee has been paid, unless before the expiration of the said term the holder of the patent pays the fee required for the further term of six or twelve years, and obtains from the Patent Office a certificate of such payment in the form which is, from time to time, adopted, which certificate shall be attached to and refer to the patent, and shall be under the signature of the com- 554
missioner or of the deputy commissioner. 56 V., c. 34, s. 3.

3. If such second payment, together with the first payment, makes up only the fee required for twelve years, then the patent shall, notwithstanding anything therein or in this Act contained, cease at the end of the term of twelve years, unless at or before the expiration of such term the holder thereof pays the further fee required for the remaining six years, making up the full term of eighteen years, and obtains a like certificate in respect thereof. 55-56 V., c. 24, s. 5.

ASSIGNMENTS. 555

25. The patent may be granted to any person to whom the inventor, entitled under this Act to obtain a patent, has assigned or bequeathed the right of obtaining the same, or in default of such assignment or bequest, to the legal representatives of the deceased inventor. 35 V., c. 26, s. 8;—36 V., c. 44, s. 2.

556 FORFEITURE OF PATENTS.

37. Every patent granted under this Act shall be subject, and be expressed to be subject, to the following conditions:—

(a.) That such patent and all the rights and privileges thereby granted shall cease and determine, and that the patent shall be null and void at the end of two years from the date thereof, unless the patentee or his legal representatives, or his assignees, within that period or any authorized extension thereof, commence, and after such commencement, continuously carry on in Canada, the construction or manufacture of
557 the invention patented, in such a manner that any person desiring to use it may obtain it, or cause it to be made for him at a reasonable price, at some manufactory or establishment for making or constructing it in Canada;

(b.) That if, after the expiration of twelve months from the granting of a patent, or any authorized extension of such period, the patentee or patentees, or any of them, or his or their representatives, or his or their assignee, for the whole or a part of his or their interest in the patent, imports, or causes to be imported into Canda, the invention
558 for which the patent is granted, such patent shall be void as to the interest of the person or persons importing or causing to be imported as aforesaid:

2. (a.) Any question which arises as to whether a patent, or any interest therein, has or has not become void: under the provisions of this section, may be adjudicated upon by the Exchequer Court of Canada, which court shall have jurisdiction to decide any such question upon information in the name of the Attorney General of Canada, or at the suit of any person interested:

3. (b.) This section shall not be held to take away or affect the jurisdiction which any Court other than the Exchequer Court of Canada possesses. 55-56 V., c. 24, s. 6. 559

2. Whenever a patentee has been unable to carry on the construction or manufacture of his invention within the two years hereinbefore mentioned, the commissioner may, at any time not more than three months before the expiration of that term, grant to the patentee an extension of the term of two years on his proving to the satisfaction of the commissioner that he was, for reasons beyond his control, prevented from complying with the above condition: 560

3. The commissioner may grant to the patentee, or to his legal representatives or assignee for the whole or any part of the patent, an extension for a further term not exceeding one year, beyond the twelve months limited by this section, during which he may import or cause to be imported into Canada the invention for which the patent is granted, if the patentee or his legal representatives, or assignee for the whole or any part of the patent, show cause, satisfactory to the commissioner, to warrant the granting of such extension; but no extension shall be granted unless application is made to the commissioner at some time within three months before the expiry of the twelve months aforesaid, or of any extension thereof. 35 V., c. 26, s. 28;—38 V., c. 14, s. 2;—45 V., c. 22, s. 1. 561

PATENT FEES.

39. The following fees shall be payable before an application for any of the purposes herein men-

562 tioned shall be received by the Commis ioner, that is to say,—

	$ cts.
Full fee for 18 years	60 00
Partial fee for 12 years	40 00
Partial fee for 6 years	20 00
Fee for further term of 12 years..	40 00
Fee for further term of 6 years....	20 00

THE LAW OF GREAT BRITAIN, IRELAND and THE ISLE OF MAN.

(From Patent Laws of the World, Collected, Edited and Indexed. By Alfred Carpmael, So-
563 licitor, etc., and Edward Carpmael, B. A. Patent Agent, etc.) Second edition, Revised. London. William Clowes and Sons, Limited, 27 Fleet St., 1889")

GREAT BRITAIN, IRELAND and THE ISLE OF MAN. LAW OF 25TH AUGUST, 1883.

Sealing of patent.

12. (1) If there is no opposition, or, in case of opposition, if the determination is in favor of the grant of a patent, the comptroller shall cause a patent to be sealed with the seal of the Patent Office.

564 (2) A patent so sealed shall have the same effect as if it were sealed with the Great Seal of the United Kingdom.

(3) A patent shall be sealed as soon as may be, and not after the expiration of fifteen months from the date of application, except in the cases hereinafter mentioned, that is to say—

(*a*) Where the sealing is delayed by an appeal to the law officer, or by opposition to

the grant of the patent, the patent may be sealed at such time as the law officer may direct. 565

(b) If the person making the application dies before the expiration of the fifteen months aforesaid, the patent may be granted to his legal representative and sealed at any time within twelve months after the death of the applicant.

Date of Patent.

13. Every patent shall be dated and sealed as of the day of the application: Provided that no proceedings shall be taken in respect of an infringement committed before the publication of the complete specification: Provided also, that in case of more than one application for a patent for the same invention, the sealing of a patent on one of those applications shall not prevent the sealing of a patent on an earlier application. 566

Provisional Protection.

14. Where an application for a patent in respect of an invention has been accepted, the invention may during the period between the date of the application and the date of sealing such patent be used and published without prejudice to the patent to be granted for the same; and such protection from the consequences of use and publication is in this Act referred to as provisioned protection. 567

Protection by Complete Specification. Effect of Acceptance of Complete Specification.

15. After the acceptance of a complete specification and until the date of sealing a patent in respect thereof, or the expiration of the time for sealing, the application shall have the like privileges

568 and rights as if a patent for the invention had been sealed on the date of the acceptance of the complete specification: Provided that an applicant shall not be entitled to institute any proceeding for infringement, unless and until a patent for the invention has been granted to him.

Extent of Patent.

16. Every patent when sealed shall have effect throughout the United Kingdom and the Isle of Man.

Term of Patent.

569 17. (1) The term limited in every patent for the duration thereof shall be fourteen years from its date.

(2) But every patent shall, notwithstanding anything therein or in this Act, cease if the patentee fails to make the prescribed payments within the prescribed times.

570

CIRCUIT COURT OF THE UNITED STATES, 571

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, vs. LEEDS & CATLIN COMPANY.	In Equity. No. 8797, 8798.
VICTOR TALKING MACHINE COMPANY, *et al.*, vs. THE TALK-O-PHONE COMPANY.	In Equity. No. 8859, 8860. 572

State and County of New York, ss.:

T. COMMERFORD MARTIN being duly sworn, says:

During the month of August, 1888, and for some time prior thereto, I was an associate editor of the Electrical World, a weekly review then published 573
in the City of New York, and at said time Mr. Joseph Wetzler was also an associate editor with me of the said Electrical World. At that time the office of the Electrical World was in the Potter Building, New York City. I have continued my connection with the Electrical World since that time down to the present day, the name of the publication now being, however, the Electrial World and Engineer, with offices at 114 Liberty Street in the City of New York.

My attention has been called to an article enti-

574 tled "The Improved Gramophone," published in the Electrical World for August 18, 1888 on page 80 thereof. Prior to August 18, 1888, Mr. Joseph Wetzler and I had known Mr. Emile Berliner. At the invitation of Mr. Emile Berliner, Mr. Joseph Wetzler and I visited Mr. Berliner in the City and County of New York. According to my present recollection we visited Mr. Berliner on the occasion stated, at the Union Square Hotel. As stated in the said article in the Electrical World for August 18, 1888, we visited Mr. Berliner on the occasion aforesaid, prior to August 18, 1888, and about a week prior to that date. Mr. Berliner in-
575 vited us to his bedroom in the hotel for the purpose of exhibiting to us the improved gramophone. Mr. Wetzler and I went to Mr. Berliner's bedroom in the hotel at said time and thereupon Mr. Emile Berliner exhibited to us the recording and reproducing of sound by means of the gramophone. I recollect that by means of the gramophone reproducing machine, Mr. Berliner played or reproduced several songs and records, as stated in the said article in the Electrical World for August 18, 1888. The reproducing machine used by Mr. Berliner on the said occasion for the reproduction of sound from the said records is illustrated in the said article in
576 the Electrisal World for August 18, 1888, being designated as the "improved Berliner Gramophone." I recollect that the reproducing stylus connected to the diaphragm was permitted to rest by its own gravity in the reproducing-groove of the record, and that when the plate was made to revolve, it not only vibrated the diaphragm and produced the sound, but it also led the diaphragm-box across the disc from periphery to center.

My recollection of the reproducing gramophone accords with the description of it given in the said article in the Electrical World for August 18, 1888.

On the occasion aforesaid, Mr. Berliner presented me with one of the records used for reproducing sound upon the machine. The disc carrying the record was made to revolve by hand, the crank being turned by the hand and causing the disc to revolve, as shown in the illustration in said article in the Electrical World for August 18, 1888. 577

I do not know what has become of the record presented by Mr. Berliner to me upon that occasion. I recollect that the record had the date marked upon it. I recollect also that upon the said occasion Mr. Berliner demonstrated to us the manner of making a record. He poured a fluid preparation upon the surface of the disc, thus coating the surface of the disc, and then traced the record into this layer or coating, as set forth in the said article in the Electrical World for August 18, 1888. 578

The article entitled "The Improved Gramophone," published in the Electrical World for August 18, 1888 on page 80 thereof as aforesiad, was written by Mr. Joseph Wetzler above named. I remember the publication of the article, the occasion referred to, the presence of Mr. Berliner, Mr. Wetzler and myself, the reproduction of sound by Mr. Berliner and myself from records thereof, by means of the gramophone reproducing machine illustrated in the said article and operated as aforesaid, and the making of a sound record by Mr. Berliner as aforesaid, and the giving of the said record to me by Mr. Berliner upon the said occasion. 579

T. COMMERFORD MARTIN.

Subscribed and sworn to before me this 10th day of November, 1905.

Walter E. Holloway,
[SEAL.] Notary Public, No. 179,
New York Co.

580 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.* vs. LEEDS & CATLIN COMPANY.	In Equity No. 8797.
VICTOR TALKING MACHINE COMPANY 581 vs. THE TALK-O-PHONE COMPANY.	In Equity No. 8859.

Kingdom of Great Britain,
County of London,
Consulate-General of the United States of America. } ss.:

Joseph Wetzler, being duly sworn, says:

582 During the month of August, 1888, and prior thereto, I was an associate editor of the Electrical World, a weekly review published in the City of New York, having its office in the Potter Building. Mr. T. Commerford Martin was at the time an associate editor of the Electrical World with me, and prior to August 18, 1888, we had both been acquainted with Mr. Emile Berliner.

As an editor of the Electrical World, I wrote the article entitled "The Improved Gramophone,"

published in the Electrical World for August 18, 1888, on page 80. Prior to August 18, 1888, Mr. Emile Berliner invited Mr. Martin and me to witness the recording and reproducing of sound by means of the gramophone, and upon such invitation Mr. Martin and I, together with one or two other persons, whose names 583

visited Mr. Berliner in the City and County of New York during the week preceding August 18, 1888. According to my recollection we visited Mr. Berliner upon said occasion at the Union Square Hotel, and Mr. Berliner then and there invited us to his bedroom where he exhibited to us the recording and reproducing of sound by means of the gramophone. What took place upon that occasion I have correctly set forth in the said article entitled "The Improved Gramophone," published in the Electrical World for August 18, 1888, on page 80 thereof. Mr. Berliner reproduced for us several sound records by means of the gramophone reproducing machine illustrated in the said article. The sound records employed were the phonautographic records. Upon the said occasion Mr. Berliner demonstrated for us the process of making a phonautographic record by etching the record into metal. As stated in the said article, "He took a small disc of zinc, poured upon it a quickly evaporating fluid which left an exceedingly thin layer of spongy and fatty wax, traced into this layer a phonautographic record and etched the same with chromic acid. In less than 15 minutes, on examining the zinc plate through a magnifying glass, we observed the beautiful tracings of articulate speech as a line sunken below the surface of the metal with all its delicate waves in most pecu- 584 585

586 liar varities as representing the various sounds of the human voice." The reproducing gramophone used by Mr. Berliner upon the said occasion is correctly described in the said article as follows:

> "As shown in the accompanying engraving there is no gear or machinery of any kind except a small friction wheel which revolves the table having clamped down upon it the reproducing disc. The reproducing stylus connected to the diaphragm is permitted to rest by its own gravity in the reproducing groove of the record, and when the plate is made to revolve it not only vi-
587 brates the diaphragm and reproduces the sound but it also leads the diaphragm box across the disc from periphery to centre so that the record groove serves at the same time as a screw instead of a separate gear. The recording diaphragm and stylus are attached to a lever which is pivoted at a distance of about 18 inches from the centre line of the disc, and as it slowly swings across the disc it describes an arc of very flat amplitude."

I remember the occasion of our visit to Mr. Berliner in the City of New York prior to August
588 18, 1888. I remember the visit itself, at which Mr. Berliner, Mr. Martin, I and others were present. I remember the making of a phonautographic record on that occasion by Mr. Berliner, by the method described in the said article. I remember the reproduction of sound by means of the gramophone, as described in said article and by means of the reproducing machine illustrated in the said article, and I remember writing the said article entitled "The Improved Gramophone," and the

publication of the said article in the Electrical 589
World for August 18, 1888, on page 80 thereof.

JOSEPH W. WETZLER.

Subscribed and sworn to before me }
this 9th day of November, 1905 }

[SEAL. Francis H. Trigout,
United States Deputy Consul-
Consulate- General of the
General, United States of
London.] America, at London.

590

591

592 February 18, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Bldg.
Philadelphia, Pa.

Dear Sir:

In reply to your favor of February 16, I beg to say that I shall be pleased to let you have a copy of my record attacking the title of the American Gramophone Company to the Jones patent. The testimony is now being printed and I hope soon to be able to send you the copy requested. In the suit against the Leeds & Catlin Company the plea
593 to the title will come on for argument soon. I am interested to know what may be the condition of the suit against your clients.

Very truly yours,

Louis Hicks.

March 2, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Building,
12th above Chestnut Street,
Philadelphia, Pa.

Dear Sir:

594 By reason of my absence from the city and pressing engagements I have been unable before to answer your favor of February 20, in regard to defendant's testimony on the plea in the suit of American Gramophone Company against Leeds & Catlin Company on the Jones patent. I was under the impression that the American Gramophone Company was suing the Victor Company on the Jones patent, although previously I had understood that some arrangement existed between the Victor and Graphophone Companies whereby the Victor Company could not be sued upon that

patent. I have recently been informed that the 595
suit which you are defending is not against the Victor Company but against the Universal Company, which I understand is controlled by the Victor Company. This presents a rather complicated situation, because if the Victor Company control the Universal Company and if the Victor Company could not be sued on the Jones patent the Universal Company would have nothing to lose by defeat. I should be very glad indeed to join hands with the Victor Company if that Company is interested in over-throwing the Jones patent. I have collected what I believe to be valuable material and evidence in defence of suits brought on the 596
Jones patent, but reflection makes me believe that it would be prejudicial to my clients to put that material and evidence at the disposal of counsel for use in other suits, unless I am fully informed of the precise situation and interests involved, and unless arrangements could be made so that the material and evidence could not be presented in the strongest possible manner. You will I am sure appreciate and understand the situation. It would not do for me to permit my material to go into your case at the very close thereof, if the proper foundation had not been laid in your case, and if the Universal Company is not for the reasons stated
or for other reasons vitally concerned in the over- 597
throwing of the Jones patent. Indeed if the Victor Company controls the Universal Company and if the Victor Company could not be sued on the Jones patent it would seem to me that the Victor Company and the Universal Company would be benefitted rather than injured by the sustaining of the Jones patent. Of course, I have no knowledge of my own and have merely heard what has been stated above; but Mr. Armstrong testified to something like this condition. As I personally

598 would like to join hands with the Victor Company, if circumstances permit, I trust that you will at once give me full information so that I may know how to act. Believe me,

Very respectfully yours,

Louis Hicks.

April 21, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Building,
Philadelphia, Pa.

Dear Sir:

599 I received your favor of April 18th requesting adjournment of the argument of the demurrers in the four suits of the Victor Talking Machine Co. v. Leeds & Catlin Co. and v. The Talk-O-Phone Co. I am ready to argue these demurrers and am anxious so to do. I do not see how the demurrers can be reached for argument during the week beginning April 25th, unless the judge calling the calendar should hear only pleas and demurrers as Judge Wallace, for instance, sometimes does, and leaves the rest of the case coming on for final hearing for some Judge who does not sit in the Circuit Court of Appeals.

600 If the suits against the American Graphophone Co. by the Victor Co. and the suits of the American Graphophone Co. v. the Victor and Universal Cos. are to go over to the session of May 15th, I have no objections to our demurrers going over to that date. I am unwilling to do anything which would permit these cases coming on unexpectedly for final hearing to acquire precedence over any one of the four demurrers. I regret that I was not able to reply to your letter before, and I trust you will pardon the delay.

Very truly yours,

Louis Hicks.

June 14, 1905. 601

Horace Pettit, Esq.,
604 Stephen Girard Building,
Philadelphia, Pa.

Dear Sir:

I beg to acknowledge receipt of your favor of June 10, 1905, with reference to the demurrers in the suits of Victor Talking Machine Company *et al.* against Leeds & Catlin Company and against the Talk-O-Phone Company (four suits). I regret to learn that you are unwilling to join with me in a request to Judge Hazel to take these demurrers for decision without oral argument and upon 602
printed briefs.

In my letter to you of April 21, I stated that I was unwilling to do anything which would permit the Victor suits against the Graphophone Company to acquire precedence over any one of the four demurrers. I repeated that statement to your assistant, Mr. Kennedy, when the equity calendar was called, and I also called your attention to my understanding with Mr. Kennedy in the statement of my letter of April 21. Nevertheless, the calendar was so arranged that the suit against the Graphophone Company was argued and the demurrers were not argued. I protest against this. 603
Had the demurrers been put upon the calendar for argument when they should have been, they would have been argued and disposed of long ago.

In view of the agreement of December 8, 1903, between the Graphophone Company and the Victor Company, the submission of the demurrers in the four suits to Judge Hazel would be particularly appropriate and timely.

Very truly yours,

Louis Hicks.

604 Nov. 20, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

Dear Sir:

With reference to the suits of the Victor T. M. Co. *et al.* against the Leeds & Catlin Co. and the Talk-O-Phone Co., I am waiting to receive from you a statement of your costs upon the overruling of the demurrers. I do not understand why you have not entered orders overruling the demurrers in order that the suits may be put at issue by the
605 filing of answers and replications, and evidence taken under the issues. In my opinion the patents sued upon are, without question, invalid, and defenses proving the invalidity of the patents exist and were not put in evidence in the suit against the American Graphophone Co. I understand that your clients have been making misleading statements to the trade, and that you have been enjoined from so doing by Judge Hazel in the suit against the Graphophone Co. It will not do for your clients to delay in bringing the above suits to final hearing, and in the meantime to make misleading statements to the trade. If this continues
606 I shall undoubtedly bring the matter before the Court for appropriate relief.

Very truly yours,

Louis Hicks.

Nov. 22, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

Dear Sir:

I have your favor of Nov. 21, stating that you will forward to me a statement of the costs upon

the overruling of the demurrers. You must know 607
that I cannot answer in the four suits of the Victor Co. against the Leeds & Catlin Co. and the Talk-O-Phone Co. until you have entered orders overruling the demurrers. Surely you do not mean seriously to say that the Judge's opinion is an order upon which I can act. It has been your duty to serve me with copies of your proposed orders overruling the demurrers with notice of settlement, the said orders to provide that defendants shall answer within thirty days from the entry of the orders, and either to tax your costs or to notify me of the amount thereof, in order that upon payment of costs within thirty days after the 608
entry of the orders I may file answers on behalf of defendants. Because you failed to put the demurrers properly on the calendar for argument, great delay ensued before the demurrers appeared on the calendar, and because you are now omitting to do the things mentioned above, great delay is occurring in bringing the suits to issue.

Very truly yours,

Louis Hicks.

Nov. 22, 1905.

Horace Pettit, Esq.,
604 Stephen Girard Bldg.,
Philadelphia, Pa. 609

Dear Sir:

I beg to acknowledge receipt of copies of your two letters dated Nov. 17, 1905, to my client, the Talk-O-Phone Co. I have repeatedly informed you that, in my opinion, the Berliner patent No. 534,543 is invalid and void, and that if it ever had any validity, it has none to-day. Furthermore, I have informed you repeatedly that I have discovered evidence which, in my opinion, without question will prove the invalidity of the patent, and

610 I have also stated to you that the evidence to which I refer was not produced in the suit brought by your client, the Victor Talking Machine Co. against the American Graphophone Co. upon said patent. As you know, Judge Hazel in rendering his decision in said suit against the American Graphophone Co. suspended all relief pending appeal.

On Sept. 26, 1904, you brought suit on patent 534,543 against the Talk-O-Phone Co., and notwithstanding my repeated protests you have delayed, and are now delaying the prosecution of the suit. In view of your threatening letters to the trade and my client, which, in my opinion, are entirely
611 without justification, and in view of my repeated statement to you that, in my opinion, patent No. 534,543 is invalid and void, I hereby notify you that unless the Victor Talking Machine Co. ceases from the sending of threatening circular letters and proceeds at once with the prosecution of its case against the Talk-O-Phone Co., in order that the question of the invalidity and nullity of the patent may, at an early date, be passed upon by the court, I shall forthwith apply to the court for appropriate relief. Your statement that the improved Talk-o-phone, operating by a mechanical feed-device, is an infringement of patent No. 534,543, supposing that said patent is not invalid
612 and void, is untenable and without justification, since you must know that mechanical feed-devices anticipated the Berliner patent by many years. On behalf of the Talk-O-Phone Co., I desire to say that your clients will be held strictly accountable for any misrepresentation made by them with reference to the improved Talk-o-phone.

Very truly yours,

Louis Hicks,
Counsel for the Talk-O-Phone Co.

Nov. 29, 1905. 613

Horace Pettit, Esq.,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

Dear Sir:

I have your favor of Nov. 27, requesting payment of costs upon the overruling of the demurrers in Victor T. M. Co. *et al.* against Leeds & Catlin Co. (two suits, Nos. 8797 and 8798). As it was only upon my urgent request that you entered the orders overruling the demurrers and sent me a statement of the amount of your costs, I did not suppose that you expected check by return mail, but 614
that I should have a reasonable opportunity to request my clients to remit the amount. However, from your letter of Nov. 27 it would seem that you desired check at once. Hence I enclose my check to your order for $30.35, being the amount named in your letter of Nov. 23. I have my answers in the suits well under way and shall file them at the earliest possible moment, as soon as the clerical work of copying can be done and signatures and verifications had. I have the first case to argue on the equity calendar for Dec. 4, and the first case in the Circuit Court of Appeals for Dec. 5. These are very important cases which have required very
much attention, but I shall let nothing else interfere with the filing of the answers in these suits, in 615
order that they may be at once brought to an issue and tried upon their merits.

Very truly yours,

Louis Hicks.

616 Mar. 16, 1906.

Horace Pettit, Esq.,
Counsel for Victor Talking Machine Co.,
604 Stephen Girard Bldg.,
Philadelphia, Pa.

Dear Sir:

The Talk-O-Phone Co. has referred to me copies of a circular letter signed and sent by you under date of March 7 and 10, 1906 to numerous customers of the Talk-O-Phone Co. You say that on behalf of your client you desire to call attention to the fact that you hold that the disc talking ma-
617 chines and records heretofore manufactured by the Talk-O-Phone Company is a clear infringement of the Victor Talking Machine Company's patents. You are well aware that the Talk-O-Phone Company has never manufactured records, and you also know that the Victor Talking Machine Company's patent for a record was recently overthrown by Judge Hazel in a decision filed Feb. 19, 1906, before the writing of your misleading and threatening letter.

With reference to the disc talking machines manufactured and sold by the Talk-O-Phone Co., you say that the Victor Talking Machine Company has now a suit pending against the Talk-O-Phone
618 Co. for infringement of Berliner patent No. 534,543, and that it is your intention promptly to move for preliminary injunction. If such has been your intention, why have you not made your motion instead of sending your threatening letters to the trade of the Talk-O-Phone Company? During the past year I have repeatedly protested against your delay in bringing your suit against the Talk-O-Phone Co. to a hearing, while you were prosecuting your suit against the American Graphophone Co. on the same patent under an

agreement between the Victor and Graphophone Companies, to the effect that if the Graphophone Co. should lose the suit, a license would be given by the Victor Co. to the Graphophone Co. to operate under the patent. I have also repeatedly informed you that in my opinion the Berliner patent No. 534,543 for gramophone is invalid, and that I am prepared to show the invalidity of the patent to the court. It is upon this Berliner patent that your suit against the Graphophone Co. was conducted and upon which you brought suit against the Talk-O-Phone Co. I desire to say that unless you move for preliminary injunction at once against the Talk-O-Phone Co. and make good your threat to the trade so to do, I will move the court to dismiss your suit against the Talk-O-Phone Co., by reason of your failure to prosecute the same. The Victor Talking Machine Co. will be held strictly accountable for the damage done to the Talk-O-Phone Co., by reason of the threatening letters and circulars heretofore sent to the trade. Why you perfer to intimidate the trade instead of making your motion for preliminary injunction is difficult to understand, unless it be that you yourself realize the invalidity of the patent upon the basis of which you make your threats. 619 620

In your letters to the trade you claim that the "mechanical feed" device by which the new and improved talk-o-phone operates is an infringement upon your said Berliner patent. You must know that your claim can have no reasonable basis, and that mechanical feed devices anticipated the Berliner patent by many years. The Talk-O-Phone Co. is prepared to show, first: that your Berliner patent No. 534,543 is invalid, and second: that the mechanical feed device is not an infringement of that patent, even if the patent were valid. I therefore, call upon you at once to make your motion 621

622 for preliminary injunction and to discontinue the sending of misleading and threatening letters to the trade.

Very truly yours,

Louis Hicks,
Counsel for Talk-O-Phone Co.

Philadelphia, March 3, 1905.

Louis Hicks, Esq.,
25 Pine Street, New York, N. Y.

Dear Sir:

I have your favor of the 2d inst., and contents
623 noted. I would say that both the Universal Talking Machine Mfg. Co. and the Victor Talking Machine Company are fighting the suit on the Jones patent as hard as they know how, and mean to leave no stone unturned in the defense.

Of the two suits against this Company the suit which is now being prosecuted is the suit in the Southern District of New York, against the Universal Talking Machine Mfg. Company. Of course, if the patent should, for any reason, be sustained in this suit after appeal, a decree could very readily be had against the Victor Company, if it should be shown that they are using the same
624 process. There is no agreement or understanding between the Victor Company and the American Graphophone Company, whatsoever looking to the bolstering up or sustaining of the Jones patent. On the other hand, we are using every effort to present as full and complete a defense in the Universal suit as possible.

All that it was my intention to ask you was to let me see a copy of your testimony taken in the suit on this patent against your client on your pleading, which testimony I understood would very shortly be filed in order to argue the plea, for which

reason I assumed you would have no objection to letting me see a copy of the same a little in advance. I was merely referring to such evidence as you may have produced concerning the title, or want of title in the A. G. Co. to the Jones patent. 625

Yours very truly,

Horace Pettit.

K.

Philadelphia, Apr. 18, 1905.

Louis Hicks, Esq.,
25 Pine St., New York City.

Dear Sir: 626

I understand there will be a one week's session of the Circuit Court beginning April 25th, and a four week's session beginning May 15th.

I suppose it will be agreeable to you, if we agree to have our Leeds & Catlin and Talk-O-Phone demurrers set for argument at the session beginning May 15th. Will you kindly let me hear from you.

Very truly yours,

Horace Pettit.

K.

Philadelphia, April 22, 1905.

Re V. T. M. Co. vs. Leeds & Catlin. 627
V. T. M. Co. vs. Talk-O-Phone Co.

Louis Hicks, Esq.,
25 Pine St., New York City.

Dear Sir:

Replying to your favor of the 21st inst. I beg to advise you that we have arranged to have the suits of the V. T. M. Co. vs. Amer. G. Co. and of the Amer. G. Co. vs. the Universal Co. heard at the

session beginning May 15th. I do not intend to try them during the week beginning April 25th.

In view of this, I understand that you have no objection to arranging to have our demurrers heard at the same session.

Very truly yours,

Horace Pettit.

K.

Philadelphia, June 10, 1905.

Victor Talking Machine Co., *et al.*
v. Leeds & Catlin Co.
Same v. The Talk-O-Phone Co.

Louis Hicks, Esq.,
25 Pine Street, New York City.

Dear Sir:

I regret very much that the demurrers in the above cases were not reached for argument upon the present equity calendar, and that they have to be postponed until fall. I doubt very much whether Judge Hazel would consider them under submission without argument, as these cases are among those which he has already formally continued until fall.

I prefer, at all events, to let the Court have the benefit of an oral argument.

Very truly yours,

Horace Pettit.

Philadelphia, June 15, 1905.

Louis Hicks, Esq.,
25 Pine St., New York City.

Dear Sir:

Referring to your favor of the 14th inst., would say that I regret very much, as stated before, that the cases could not be reached for argument on the

Equity calendar just concluded, I, of course, have 631
nothing to do with the arrangement of the calendar, and the fact that the cases were not reached was, of course, the fault of neither of us. I was particularly anxious to have these demurrers argued at this Term of Court, but, as indicated in my last letter, while I think there is nothing in the points which you raise, I desired the opportunity of an oral argument, which, therefore, precluded submitting the demurrers on brief.

Very truly yours,

Horace Pettit.

P.

Victor Talking Machine Company, 632
Camden, N. J., March 6, 1906.

To the Trade :

We beg to advise you that we have just received a communication from our counsel, Horace Pettit, Esq., notifying us that the United States Circuit Court of Appeals, of New York, in our suit against the American Graphophone Company, filed an opinion, March 1st, 1906, in our favor, affirming the decision of Judge Hazel of the lower court, of September 21st, 1905, sustaining our fundamental Berliner patent, No. 534,543, for the combination of our disc talking machines and records and 633
method of operating the same.

As the decision of this Court is final, we expect to at once proceed to enforce our rights by preliminary injunction against all infringers, including all manufacturers of infringing machines and records, who have not taken a license from us, and dealers in such infringing goods. We would call your attention to the fact that the American Graphophone Company has already taken a license, as also the Universal Talking Machine Manufacturing Company.

Yours very truly,

Leon F. Douglass,

Vice-Presdt.

634 Philadelphia, March, 7, 1906.

Messrs. J. P. Crotty & Co.,
Minneapolis, Minn.

Gentlemen:

My client, the Victor Talking Machine Company, of Camden, N. J., has reason to believe that you are selling and handling, or about to sell and handle, disc talking machines and records manufactured and sold, and advertised for sale, by a company known as the Talk-O-Phone Company, having an office, among other places, in Toledo, Ohio.

635 On behalf of my client, I desire to call your attention to the fact that we hold that the disc talking machine and records heretofore manufactured by the Talk-O-Phone Company is a clear infringement of the Victor Talking Machine Company's patents, among other, the Berliner patent No. 534,543, issued February 19, 1895, for Gramophone. The disc talking machine manufactured and sold by the Talk-O-Phone Company is, we contend, a clear infringement of claims 5 and 35 of this patent, which have just been sustained by the United States Circuit Court of Appeals of New York, in a decision filed March 1, 1906, affirming the decision of Judge Hazel in the Court below in
636 the suit of the Victor Talking Machine Company against the American Graphophone Company. The claims sustained cover the reproducing apparatus and method of operating the same, such as embodied in the said Talk-O-Phone machines for reproducing sound from disc records.

The Victor Talking Machine Company has now a suit pending in the United States Circuit Court for the Southern District of New York against the said Talk-O-Phone Company, for infringement of the said patent, which will be expeditiously prosecuted, and I would add that it is our intention to promptly move for preliminary injunction.

We also learn from certain advertisements of the 637
Talk-O-Phone Company, that since the decision of the Lower Court of September 21, 1905, sustaining this Berliner Patent, No. 534,543, the Talk-O-Phone Company has been advertising and illustrating in its advertisements, a disc talking machine constructed and operated substantially in accordance with the said claims of the said Berliner Patent No. 534,543, with a so-called "mechanical feed" device, superadded, as we believe, in an attempt to evade the claims of this patent. We desire also to call attention to the fact that, as we understand this mechanical feed device, it can have no useful function to perform, and we 638
believe it to be added merely as an attempt to evade our patent. We believe that this attempt will be regarded by the Courts as a mere evasion, and will be held to infringe the claims.

We desire to give you notice of this fact, as it is only fair that you should have knowledge that the Victor Company regards this Talk-O-Phone machine with the so-called "mechanical feed" for reproducing from disc records, which is being quite extensively advertised, as a clear infringement of its said patent, as well as the machine which the Talk-O-Phone Company has been heretofore manufacturing and selling, and that it embodies the principle and features of our said fundamental 639
patent, notwithstanding certain statements made by the Talk-O-Phone Company to the contrary.

I will be pleased to give you further information relative to the decisions sustaining this patent, and to forward you a copy upon hearing from you, or your counsel.

I remain,

Yours very truly,

Horace Pettit.

The same to Keen Talking Machine Company, Philadelphia, Pa., dated March 10, 1906.

The same to Rogers Manufacturing Company, New York City, dated March 10, 1906.

640 At a stated term of the Circuit Court of the United States, for the Southern District of New York, held in the court-room in the County of New York on the day of June, 1905.

Present—Hon. JOHN R. HAZEL, U. S. Judge.

VICTOR TALKING MACHINE COMPANY, *et al.*, Complainant, vs. TALK-O-PHONE COMPANY. Defendant.	Nos. 8859 and 8860 on Berliner Patents Nos. 534,543 and 548,623.
VICTOR TALKING MACHINE COMPANY, *et al.*, Complainant, vs. LEEDS & CATLIN COMPANY, Defendant.	Nos. 8797 and 8798 on Berliner Patents Nos. 534,543 and 548,623.

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The suit of the Victor Talking Machine Company *et al.* against the American Graphophone Company on Berliner Patent No. 534543, having come on to be heard at final hearing, and having been argued at final hearing before me on June 5 and June 6, 1905, by counsel for complainants and defendant in that suit, and at the close of the argument on June 6, 1905, Louis Hicks, solicitor and counsel for defend-

ants in the four above entitled suits against the 643
Leeds & Catlin Company and the Talk-o-Phone Company, having moved the Court for permission to address the Court with reference to the contract of December 8, 1903, between the Victor Talking Machine Company and the American Graphophone Company appearing in the record in said suit between said two Companies; on reading and filing the annexed affidavit of Louis Hicks, verified June 8th, 1905, it is

Ordered that the said motion be, and the same hereby is denied.

U. S. Judge. 644

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646 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, Complainants, vs. TALK-O-PHONE COMPANY, Defendant.	In Equity. Two Suits Nos. 8859 and 8860. Berliner Patents Nos. 534,543 and 548,623.

647

VICTOR TALKING MACHINE COMPANY, *et al.*, Complainants, vs. LEEDS & CATLIN COMPANY, Defendant.	In Equity. Two Suits Nos. 8797 and 8798. Berliner Patents Nos. 534,543 and 548,623.

State and County of New York, ss.:

Louis Hicks, being duly sworn, says: that he is
648 a solicitor and counsel for the defendants in the above four suits in equity now pending undetermined in this Court upon the Berliner Patents above named; that each of the above four suits is at issue on demurrer; has been ready for argument at each session of the April, 1905, Term of this Court; that deponent is also solicitor and counsel for the above named defendants in two suits on the Jones Patent, brought by the American Graphophone Company; that the said two suits on the Jones Patent were argued on plea and demurrer before Judge Hazel on May 31, 1905; that in addition to

the foregoing six suits on the said Jones and Ber- 649
liner patents there appeared on the same April, 1905, Term of this Court, a suit of the American Graphophone Company against the Universal Talking Machine Company on the said Jones Patent, ready for final hearing and the suit by the Victor Talking Machine Company, *et al.* against the American Graphophone Company on said Berliner Patent No. 534543, also ready for final hearing; that on motion of S. O. Edmonds, Esq., counsel for the American Record Company, against which a suit had been brought by the American Graphophone Company on said Jones Patent, his Honor, Judge Platt, deferred the argument at 650
final hearing in the Graphophone Company's suit on the Jones Patent against the Universal Talking Machine Company, to the end that other parties defending suits upon the same patent should have an opportunity to present their defenses to suits based upon said Jones Patent; that the Universal Talking Machine Company is owned or controlled by the Victor Talking Machine Company; that on June 5 and 6, 1905, the suit of the Victor Talking Machine Company against the American Graphophone Company on said Berliner Patent No. 534543, was argued at final hearing; that it appeared upon the argument and from the record in
said suit that a contract dated December 8, 1903, 651
exists between the Victor Talking Machine Company and the American Graphophone Company with reference to said Jones and Berliner Patents; that deponent did not learn of the existence of that contract or the contents thereof, until said argument on June 5, 1905; that on March 2, 1905, deponent wrote to Horace Pettit, Esq., counsel for the Victor Talking Machine Company with reference to the suit pending against the Universal Talking Machine Company on the Jones Patent,

652 stating that he was informed that the Victor Talking Machine Company controlled the Universal Company, and that some agreement existed between the American Graphophone Company and the Victor Talking Machine Company by virtue of which it would not be to the interest of the Victor Talking Machine Company to defeat the suit brought by the Graphophone Company on the said Jones Patent, and requested information as to the precise situation and interests involved as a condition precedent to the giving by deponent to Mr. Pettit of material collected by deponent with reference to the said Jones Patent; that on March
653 3, 1905, Mr. Pettit replied to deponent's letter of March 2, 1905, which mislead deponent because Mr. Pettit made no mention of the contract of December 8, 1903, above mentioned, and said with reference to suit against the Universal and the Victor Companies on the Jones Patent as follows: "Of the two suits against this Company the suit which is now being prosecuted is the suit in the Southern District of New York against the Universal Talking Machine Company. Of course, if the patent should, for any reason, be sustained in this suit after appeal, a decree could very readily be had against the Victor Company, if it should be shown that they are using the same process.
654 There is no agreement or undertaking between the Victor Company and the American Graphophone Company whatsoever looking to the bolstering up or sustaining of the Jones Patent. On the other hand, we are using every effort to present as full and complete a defense in the Universal suit as possible."

When deponent learned on June 5, 1905, of the agreement of December 8, 1903, it conclusively appeared to deponent that the suit between the American Graphophone Company and the Victor

Talking Machine Company on Berliner Patent No. 534543, was a suit in which the American Graphophone Company had nothing to lose and that the American Graphophone Company as well as the Victor Talking Machine Company would be benefited if the said Berliner Patent were held by the Court to be valid, and if infringement thereof were found; that it further appeared to deponent that the said suit was a suit which would not affect the American Graphophone Company if the patent were sustained, but would affect the competitors of the American Graphophone Company and the Victor Talking Machine Company by reason of the provisions of the Contract of December 8, 1903. That it appears from Paragraphs 3 and 4 of the said contract of December 8, 1903, that in case the said Berliner Patent is sustained against the Graphophone Company, the Graphophone Company shall assist the Victor Company in the prosecution of suits upon the said patent against other parties, and that in case the said Jones Patent is sustained in the suit of the Graphophone Company against the Victor Company the Victor Company shall assist the Graphophone Company in the prosecution of suits upon the Jones Patent against other parties. The other provisions of the contract of December 8, 1903, are of like purport and affect. 655 656 657

By reason of the premises and of such information as deponent had, deponent as solicitor and counsel for the defendants named, joined with Waldo G. Morse, representing other parties in interest, in a motion addressed to the Court, held by his Honor, Judge Hazel, for permission to address the Court with reference to said agreement of December 8, 1903, and for permission to file a memorandum in regard thereto. It being deponent's opinion that it was necessary for the protection of his clients, the defendants above named, to point out

658 to the Court the apparent purpose and effect of the agreement of December 8, 1903, and the protest of defendants above named against the entertaining by the Court of the said suit on said Berliner Patent in view of the circumstances disclosed by the agreement of December 8, 1903, and against any decision in such suit or the use of any decision in such suit as a basis for relief by way of preliminary injunction against other persons sued by the Victor Company upon said Berliner Patent. His Honor, Judge Hazel, in denying the respective applications of Mr. Morse and of deponent, stated that an entry might be made in
659 the minutes of the Court, and in order that the position of these defendants may be made matter of record, the annexed order is hereby presented to the Court in order that it may be signed and filed at once among the other papers in the above entitled suits.

LOUIS HICKS.

Subscribed and sworn to before me
this 8th day of June, 1905.

[SEAL.] T. P. Dalton,
Notary Public,
Kings Co.

Certificate filed in New York Co.

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At a stated term of the Circuit Court of the United States, for the Southern District of New York, held in the Court-room in the County of New York, on the day of June, 1905. 661

Present—Hon. JOHN R. HAZEL, U. S. Judge.

VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

AMERICAN GRAPHOPHONE COMPANY,
Defendant.

On Berliner Patent No. 534,543. 662

The suit of the Victor Talking Machine Company, *et al.*, against the American Graphophone Company on Berliner Patent No. 534543, having come on to be heard at final hearing, and having been argued at final hearing before me on June 5 and June 6, 1905, by counsel for complainants and defendant in that suit, and at the close of the argument on June 6, 1905, Louis Hicks, solicitor 663 and counsel for the Talk-o-Phone Company and Leeds & Catlin Company, having moved the Court for permission to address the Court with reference to the contract of December 8, 1903, between the Victor Talking Machine Company and the American Graphophone Company, appearing in the record in said suit between said two Companies; on reading and filing the annexed affidavit of Louis Hicks, verified June 8th, 1905, it is:

Ordered that the said motion be, and the same hereby is denied.

U. S. Judge.

664 June 16, 1905.

Hon. John R. Hazel,
Care Hon. John A. Shields,
Clerk United States Circuit Court,
Post Office Building, New York.

Dear Sir:

I am in receipt from Louis Hicks, Esq., attorney for the defendant in the cases Victor Talking Machine Co., *et al.* vs. Leeds & Catlin Co., and Victor Talking Machine Co. *et al.* vs. the Talk-O-Phone Co., of a communication addressed to you, signed by Mr. Hicks, and
665 dated June 12, 1905, submitting to you for your signature for filing a proposed order entitled in the above entitled cases, with an affidavit of Mr. Hicks attached, containing the statement of certain alleged facts in connection with another suit, viz.: Victor Talking Machine Co., *et al.* vs. American Graphophone Co., which latter case your Honor heard on final hearing on the 5th and 6th inst.

I desire to call your Honor's attention to the fact that the cases against Leeds & Catlin Co., and against the Talk-O-Phone Co., in which this order and affidavit are entitled, have not been before your Honor, and you cannot very
666 well enter such an order, as suggested, in these cases. The proposed order submitted by Mr. Hicks, recites an application made by him to your Honor, for permission to address the Court in the case against the American Graphophone Co., which your Honor heard—the Talk-O-Phone Co. and against Leeds & Catlin Co. The motion referred to in the proposed order is entirely foreign to those last mentioned cases.

You will probably recall that the order entered on the 9th inst., at the instance of Mr. Waldo G. Morse, was entitled in Victor Talking Machine

Co. vs. American Graphophone Co., which was the case your Honor heard on final hearing. It would, therefore appear to be improper to enter this proposed order in these cases against Leeds & Catlin Co., and against the Talk-O-Phone Co., which your Honor has not had before you. 667

Regretting to annoy you again in this matter, I remain,

Yours very truly,

Horace Pettit.

June 12, 1905.

Hon. John R. Hazel, U. S. Judge,

Dear Sir: 668

My motion for leave to address the Court or to submit a memorandum with reference to the contract of December 8, 1903, appearing in the suit between the Victor Talking Machine Company and the American Graphophone Company upon Berliner patent No. 534,543, having been denied, I respectfully submit for signature and filing an order to that effect, to the end that the record of the motion may be preserved.

Very truly yours,

Louis Hicks,

Counsel for Leeds & Catlin Company, 669
and the Talk-o-Phone Company.

P. S.—Mr. Pettit suggests that the order should be entitled in the suit of Victor Talking Machine Company vs. American Graphophone Company. Judge Platt, however, in putting the suit of American Graphophone Company vs. Universal Talking Machine Company on the Jones patent over, signed an order in American Graphophone Company vs. American Record Company (Law Journal, May 24, 1905), Mr. Edmonds, who made the motion, being solicitor for American Record Company. The

670 four suits of the Victor Company against the Talk-o-Phone Company and Leeds & Catlin Company were on the calendar ready for hearing before your Honor, and the order presented should properly be made in these suits. It is immaterial in which suit the order is entered; hence, if your Honor should be of opinion that it should be made in Victor Talking Machine Company vs. American Graphophone Company, I have no objection and present the same order entitled in that suit.

AGREEMENT.

This agreement made this Eighth day of Decem-
671 ber, 1903, between the Victor Talking Machine Company, a corporation organized and existing under the Laws of the State of New Jersey (hereinafter called the "Victor Company") and the American Graphophone Company, a corporation organized and existing under the Laws of the State of West Virginia (hereinafter called the "Graphophone Company").

WITNESSETH:—

Whereas the Victor Company has received a license from the Berliner Gramophone Company, a corporation organized and existing under the Laws
672 of the State of Virginia, to manufacture, sell and deal in gramophones and gramophone goods, the subject matter of certain United States Patents issued to Emile Berliner, which said patents have never been adjudicated, so that their scope and validity are not ascertained, to wit:—

No. 372,786, issued November 8, 1887;
No. 382,790, issued May 15, 1888;
No. 534,543, issued February 19, 1895;
No. 548,623, issued October 29, 1895;
No. 564,586, issued July 28, 1896;

Whereas, the Graphophone Company is desir- 673
ous of operating under said patents, provided any claim thereof be sustained so as to control either the zig-zag sound-records, or the process or apparatus for making the same, or the machine for reproducing therefrom, and is desirous of co-operating with said Victor Company in every lawful way to procure as speedily as possible a judicial construction of said patents, or some of them, and

Whereas, the Graphophone Company is the owner of the Patent No. 688,739, granted December 10, 1901, to one Joseph W. Jones, for a method of making Zig-Zag Sound Records, and of the patent No. 714,651, granted November 25, 1902, to Thomas H. 674
Macdonald for Improvement in Recording and Reproducing Sounds, which patents have not been adjudicated, so that their scope and validity have not yet been ascertained, and

Whereas, said Victor Company is desirous of securing a license for making zig-zag records under said patents respectively, provided any claim thereof be sustained broadly, so as to control the said method of making zig-zag sound records; and sound records;

NOW, THEREFORE, in consideration of One dollar in hand paid by each party to the other, and of other valuable and sufficient considerations, re- 675
ceipt whereof is hereby acknowledged, the parties have hereby covenanted and agreed as follows:

1. The said Graphophone Company shall not delay any of the infringement suits now pending or hereafter to be brought against it, by those who own and control the said Berliner patents, but shall do all in its power to speed the said suits to final hearing and final adjudication, using all lawful means to defend the said suits, the object of this portion of the agreement being that the question of the validity of the said Berliner patents, shall be

676 fully tried as speedily as possible, so that their value may be known and determined at an early date.

2. In case, at final hearing, one or more of said patents as to any broad claim or claims thereof, be sustained by the Court, past royalties and damages shall be waived and the Graphophone Company shall thereafter during the lifetime of said patent or patents, and so long as it uses the subject matter of such sustained claim or claims thereof (unless and until such decision be reversed) pay to the Victor Company by monthly payments, royalties at the following rates. If the sustained claim
677 relates to machines, the royalty shall be
; if the sustained claim relates to sound-records, the royalty shall be the basis under which this royalty shall be estimated to be per cent. of the list prices of said machines and records.

3. In case one or more claim or claims of the said patent or patents be sustained as provided in Paragraph 2, the said Graphophone Company shall thereafter, whenever so requested in writing by the Victor Company, assist it in the prosecution of its suits brought and to be brought under the said Berliner Patents against other parties, by furnishing its own counsel at its own expense, Court costs
678 to be divided, each party paying one half, it being understood that the direction and control of said suits shall be entirely in the hands of the Victor Company.

4. The said Victor Company agrees to co-operate with the Graphophone Company in adjudicating said Jones Patent and said Macdonald Patent in the same manner as provided in Paragraphs 1 and 3 hereof, with respect to the said Berliner patents, the direction or control of any suits brought under said Jones Patent and Macdonald patents to be in the hands of said Graphophone Company.

5. In case, at final hearing, said Jones patent No. 679
688,739, or said Macdonald patent No. 714,651, be sustained as to any broad claim or claims thereof, past royalties and damages shall be waived, and the said Victor Company shall thereafter during the lifetime of the said sustained patent or patents so long as it uses the subject matter of the sustained claim or claims of either or both patents (unless and until such decision be reversed) pay to the Graphophone Company by monthly payments, royalties upon all such sound-records, sold by it, at the rate of the basis under which this royalty shall be estimated to be per cent. of the list prices of said records. 680

6. It is understood and agreed that the provision herein contained relative to the payment of royalties by the respective parties, shall become operative upon the decision of any infringement suit upon final hearing based upon any of the patents, as herein provided for, which the parties hereto hereafter agree in writing between themselves shall be considered as a test case whether such case to be agreed upon as a test case shall be between the parties hereto or against other defendants.

7. It is further agreed when any of said patent or patents shall be so adjudicated as valid, that the party owning or controlling such patent or patents, 681
will, with due diligence actively proceed against all infringers of its said patent or patents to enjoin such infringing parties from said infringements, and for an accounting when requested, in writing to proceed against any such alleged infringers by the other party hereto.

8. It is further agreed that neither party to this contract shall copy, or reproduce in any manner, any records owned or controlled, or first produced, by the other party, nor will they deal in or handle

682 in any manner whatsoever, such copies if made by others and that they will co-operate to secure a discontinuance of such acts on the part of others, and to secure legislation making it illegal to copy or counterfeit records, if it shall be found that the present laws do not cover the case.

9. In case any claim or claims, of any of the Victor Company's Patents will be sustained, as provided in Paragraph 2 of this agreement, the Graphophone Company shall thereafter furnish unto the Victor Company, monthly, on the first day of each month, during the existence of this agreement, a correct sworn statement of all said pat-
683 ented machines and records sold by it during the preceding month, and the Victor Company, in case any claims of the said patents of the Graphophone Company shall be sustained as provided in said Paragraph 2, shall thereafter furnish unto the Graphophone Company monthly during the existence of this agreement, a correct sworn statement of all such patented records sold by it during the previous month. Each party shall keep books of account of all such patented goods sold by them respectively. In the event of any disagreement between the parties as to any statement to be furnished, the matter shall be referred for settlement
684 to a firm of disinterested public auditors to be agreed upon by both parties, which firm of auditors shall be privileged to examine the books of either, or both, parties and the report of said auditors shall be final.

10. It is covenanted and agreed by and between the parties hereto that no right is hereby granted or conferred, directly or indirectly, to the Graphophone Company to use the name, or word, "Gramophone" in connection with talking machines, records or accessories, or in any

way whatsoever, and that no right is 685
hereby granted or conferred to the Victor Company to use the name, or word, "Graphophone" relative to talking machines, records or accessories, or in any way whatsover; the right to the use of the said respective words belonging to the said respective parties being expressly reserved in the respective parties, and each of the parties hereto covenant and agree that it will not use the said name, or word, belonging to the other party.

11. The rights herein provided for shall be personal to the parties to whom the same may be granted, and not assignable or any rights herein whatsoever, without the special consent in writ- 686
ing of the grantor.

IN TESTIMONY WHEREOF, the parties have executed this agreement the day and year first above written.

VICTOR TALKING MACHINE CO.,
Eldridge R. Johnson, Pres.

Attest:
Albert C. Middleton, Sec'y.
AMERICAN GRAPHOPHONE CO.,
By E. D. Easton, Pres.

Attest: 687
E. C. V. Rockwood.

Witnesses:
Charles K. Haddon.
A. C. Bowman.
Philip Mauro.
Horace Pettit.

688 **Testimony of Emile Berliner in Suit of Victor Talking Machine Co. et al. vs. American Graphophone Co. on Patent No. 534,543, being Suit No. 8627 in U. S. Circuit Court, Southern District of New York.**

Washington, D. C.

Mar. 20, 1905; 10 A. M.

And thereupon Emile Berliner, a witness produced on behalf of defendant, being duly sworn, deposes and says, in answer to questions by Mr. Mauro, as follows:—

689 Q 1. Please state your name, residence and occupation? A. Emile Berliner, Washington, D. C., inventor.

Q. 2. Are you the same Emile Berliner upon whose application the patent in suit No. 534,543 was granted to the United States Gramophone Company as assignee? A. I am.

Q. 3. In the prosecution of the application for that patent, you filed an affidavit, verified April 23, 1904, in which reference was made to an article entitled "Berliner's Gramophone" published in the "Electrical World" for Nov. 12, 1887. That
690 article, I understand, was prepared by yourself; is that correct? A. I prepared the article, and sent it to the "Electrical World" with the suggestion of publishing the subject matter thereof, and it probably followed the verbatim description of my invention, adding only so much as to show that the ideas published were my own.

Q. 4. Have you a copy of that publication? A. I have here a copy of the issue of the Electrical World of Nov. 12, 1887, containing the article.

Q. 5. Will you be kind enough to compare with the published article the extract therefrom included in your said affidavit, which appears in Defendant's Exhibit, file and contents of patent in suit, and which extract I will now read to you? Having made that comparison, will you please state whether the passage is correctly quoted in your said affidavit? A. I have compared your reading of the passage with the original publication and find it correct. 691

Q. 6. Did you, on or about May 16, 1888, read at a stated meeting of the Franklin Institute in Philadelphia, a paper on the subject of "The Gramophone; Etching the Human Voice?" A. I did. 692

Q. 7. In what hall or building was that meeting held? A. In the regular lecture hall of the Franklin Institute in Philadelphia.

Q. 8. About how many people were in the audience? A. I should say about 200.

Q. 9. Was that paper published in the procedings of the Franklin Institute for the month of June, 1888? A. It was.

Q. 10. And have you with you a copy of that publication? A. I have a copy of a reprint from the original publication. 693

Q. 11. Will you please look at Defendant's Exhibit, Berliner Franklin Institute Paper, the same being a pamphlet stating on title page that it is published by the U. S. Gramophone Co. of Washington, D. C., and s e that if that is one of the reprints of that paper? A. The copy presented to me is a reprint of that same publication.

Q. 12. Did you at that meeting etch one or more sound-records by means of the recording apparatus, such as illustrated on page 15 of that reprint,

694 as indicated under the heading "Demonstrations" on page 16 of that paper? A. I etched one record, traced by means of the recording apparatus, illustrated on page 15.

Q. 13. Did you at that meeting use in reproducing one or more phonautograms, which you had prepared previously to the meeting, the reproducing apparatus illustrated in the second cut on page 17 of said paper, and there marked "Reproducing apparatus, May, 1888?" A. I had with me at that lecture a number of records previously etched in Washington and I reproduced them with such reproducing apparatus as is illustrated on page 17 of
695 the pamphlet.

Q. 14. Will you please describe briefly the construction and operation of the mounting of that reproducing apparatus, with reference to the movement of the same across the tablet? A. The reproducing diaphragm sound-box was mounted at the end of a pivoted lever, to it attached was a rubber tube which led to a horn mounted on the violin music stand. The stylus of the reproducing sound-box was placed into the outer circle of the spiral of the record, and upon turning the table, upon which the record was mounted, the sound-box was
696 propelled freely across the record-disc by and along the volute of the record.

Q. 15. On page 18 of that publication, reference is made to Werner Suess. Is he the same Werner Suess on whose application, letters-patent No. 427,279 (Defendant's Exhibit, Suess Patent) was granted to you as assignee?

Counsel for complainants objects to the question as incompetent, irrelevant and immaterial; also to this line of examination of the witness in the foregoing questions, relative to the said Franklin Institute lecture

and publication as incompetent, irrelevant and immaterial, and notice is hereby given that motion will be made at the hearing to strike the same from the record, this objection being also noted to questions relative to the same line of examination hereafter to be asked the witness without a repetition of the objection being noted. 697

A. He is the same Werner Suess.

Q. 16. Was Mr. Suess' invention, set forth in that patent, assigned to you for foreign countries as well as for the United States, and did you procure patents therefor in certain foreign countries? A. At the time that the American patent was assigned to me, there was no agreement between Mr. Suess and myself with regard to foreign patents. 698

Q. 17. I call your attention to Defendant's Exhibit, Suess French Patent, which is dated May 6, 1890, the same date as the U. S. Patent No. 427,279. and ask you whether or not that French patent was taken out by you or for you?

Question objected to as incompetent, irrelevant and immaterial.

A. I had nothing to do directly with the taking out of either the American or this French patent. I was in Europe at the time they were applied for. Of course, I understood that Mr. Suess was to apply for an American patent, but with regard to the French patent, I have no recollection whatsoever of having suggested it to Mr. Suess; in fact I am quite sure that I did not do so. 699

Q. 18. Did you have any interest in this French patent?

Same objection.

A. Not at the time when it was taken out, although some years afterwards I believe it was

700 merged into the European interests with which I was connected.

Q. 19. Was this patent taken out with your knowledge and consent; the French patent, I mean?

Same objection.

A. As before stated, I knew nothing about it at the time it was taken out.

Q. 20. Did you pay any part of the costs of proceeding that French patent?

Same objection.

701 A. No.

Q. 21. Are you financially interested in the complainant companies, the Victor Talking Machine Co. and the U. S. Gramophone Co.? A. I am.

Q. 22. Did you instruct or advise Mr. Suess to make his application for patent through Mr. Joseph Lyons?

Same objection.

A. Mr. Suess knew that all my patents were prosecuted by Mr. Joseph Lyons, and he probably surmised that it would be my desire that his American patent be prosecuted also by Mr. Lyons.

Q. 23. At the time Mr. Suess' patent was applied
702 for, he was an employee of yours, was he not? A. He was.

Q. 24. Did your contract of employment with him provide or contemplate that talking-machine inventions which he might make while in your employ should be assigned to you? A. I do not recollect that we had any written agreement with regard to Mr. Suess' services, except that he was paid a certain salary by the week or by the month.

Q. 25. What I wanted to get at was, whether the invention described in Suess' Patent No. 427,279 became your property in consequence of his rela-

tion with you as employee, or in consequence of a special arrangement? A. There was no special arrangement, but when he suggested the movable arm, I at once told him that I, of course, desired to be the assignee of the patent. I had in my mind at all times that my employees who worked under my direction in my laboratory were under certain obligations by law to turn over to me any invention which they would make in the course of their work for me and under my directions. I generally made it a rule to give them a special compensation as an encouragement for the special interest taken by them in my work, and it was under this condition of mind that I asked Mr. Suess to take out an American patent and assign the same to me. 703 704

Q. 26. Did Mr. Suess accept this view of the obligations of his employment.

Objected to as clearly incompetent; further as irrevelant and immaterial.

A. He evidently did, as he made no objection to turning over the patent to me.

Q. 27. Mr. Suess is no longer living, is he? A. He died several years ago.

Cross-examination by Mr. Pettit:

XQ. 28. In the publication of the "Electrical World" of Nov. 12, 1887, offered in evidence by the defendant, and to which you have referred in your direct-examination, the following is stated, among other things, in describing the invention:— 705

"Another way is to mount the phonoautogram on a circular, wooden resonant box, which simply rotates without progressive motion, and to press an ivory point into the groove.

In this case the hand which holds the ivory easily follows the groove, and the point is

706 led along the volute of the record, and vibrates the sound box by undulatory shocks."

You may state whose invention this arrangement of apparatus and method was, as described by you in the part just quoted? A. It was my own invention.

XQ. 29. You may state whether Mr. Suess had anything to do with inventing this construction of apparatus and method just quoted? A. Mr. Suess was not then in my employ, and he had nothing to do with this idea.

XQ. 30. When you stated in this description, just quoted "and the point is led along the volute of the
707 record," what did you mean by the word "led?" A. I meant by the word "led" the engaging, taking hold of and propelling of the stylus by the record-groove, at the same time that it is vibrated.

XQ. 31. What function did the hand perform which held the ivory stylus, as described? A. The hand was the stylus-holder merely.

XQ. 32. What do you mean by that? A. I mean that the hand holding and lightly pressing the stylus into the record-groove, was forced to follow the latter from the pheriphery to center of the record.

XQ. 33. You then suggested in this article, and
708 described one of the mechanical devices for mounting a reproducing diaphragm and stylus, so as to permit the stylus not only to vibrate but at the same time to carry it across the revolving disc. The statement referred to immediately following the last statement quoted, reads as follows:—

> "This suggests the plan of mounting a reproducing diaphragm and stylus on a carriage moving on rails, and permitting the pointed stylus not only to vibrate but also to push the carriage across the revolving disc,

and thereby follow the volute of the sound record." 709

I ask you to look at U. S. patent No. 564,586, issued to you July 26, 1896, for Gramophones, marked Defendant's Exhibit, Berliner Patent No. 564,586, and state whether the construction of apparatus specified in the portion just quoted from the "Electrical World" is illustrated in Fig. 10 of the drawings of this patent? A. The patent quoted was applied for a few days before the publication of the quoted article in the "Electrical World," and the illustration of Fig. 10 in said patent is the same construction I had in mind when I prepared the article of the "Electrical World." 710

XQ. 34. I quote now from the specification of the Berliner patent No. 564,586, page 4, lines 110-123, and ask you whether this is a correct description of the apparatus and method illustrated in Fig. 10 of said patent:

"The diaphragm-casing 31 is secured to a small truck 55 upon rails 56 arranged vertically above and parallel with a diameter of the reproducing-disc, and at such height above the same that the stylus 29 will be in engagement with the undulatory grooves of even depth which represent the record of sounds. 711

The listener applies his ear to the earpiece, and when the shaft 6′ is rotated the stylus and diaphragm will be forced to vibrate, as in the apparatus shown in Fig. 1, but will at the same time move with the truck 55 across the face of the disc 54."

Objected to as incompetent and clearly not germane to the direct-examination. If complainant desires to have Mr. Berliner's testimony with reference to his patent No.

712 564,586 it should be taken as part of complainant's case.

A. The description quoted correctly describes the function of the apparatus described in Fig. 10.

XQ. 35. Does it also clearly describe the apparatus there illustrated? A. Yes.

XQ. 36. What moves the truck in the construction of this same Fig. 10, across the track?

Same objection.

A. The record groove, being in hard resisting material, presses against the stylus 29 which is firmly attached to the diaphragm-box 31 which again is
713 connected to truck 55, and as the record-groove is a spiral, in rotating the same the truck 55, is moved across the record disc. This is facilitated by the two wheels of the truck, which enable the latter to freely roll on the wire 56 when pressed by the record-groove acting against the point of the stylus.

It is hereby stipulated and agreed by counsel for complainant that Suess' French patent No. 205,491 appears to be the same as U. S. patent No. 534,543 and may be treated as such subject to correction.

Cross-examination closed.

714 Certificate and signature waived.

Defendant rests.

Testimony of Emile Berliner in Rebuttal in Same Suit.

715

Philadelphia, April 14, 1905.

By Mr. Pettit:

Q1. You are the Emile Berliner, who has testified in this case before, having been called as a witness by the defendant, are you not? A. I am.

Q2. You may state whether you are the inventor and patentee of the invemtion claimed in the patent in suit, No. 534543? A.. I am.

Q3. In your deposition of March 20, 1905, in this suit, you testified, amongg other things, to the construction of apparatus shown in Fig. 10 of Berliner patent No. 564586 issued to you July 28, 1896, and filed November 7, 1887, which is illustrated and described in this patent. Will you kindly produce, if you can, a model embodying the construction illustrated and described in Fig. 10, of the said Patent No. 5645886? A. I hereby produce a model which is practically a copy of a device used by me in 1887 about the time that the patent in question was filed. We did not then have a box motor machine, and the records were larger, and the mounting of the rail on which the carriage moved was on separate posts, but otherwise this is such a construction as I then made and successfully operated.

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The witness, in answering the above question, has produced the model referred to, which is offered in evidence and marked "Complainants' Exhibit, Berliner Model."

Q4. Do you know what became of the original apparatus similar to this model which you just produced? A. I do not.

Q5. Have you made any search for it? A. I made a search for it in the lasst few days, but did not

718 find any part of it. I might state that I have in my possession what I believe is part of the turntable used at that time, but I have nothing of the mechanism, the rail and carriage then used.

Q6. You may state when the device, such as claimed in claim 35 of the patent in suit, embodying the process or method claimed in claim 5, was first sold and put in public use by you, or any one, to your knowledge, in this country? A. In 1894, the United States Gramophone Company being the assignee of my gramophone patents, began the manufacturing and the sale of gramophones embodying the inven-
719 tion claimed in claims 5 and 35 of the patent in suit, and a large number of such machines were sold in the Autumn of 1894. This was the first time that talking machines were sold, in which a feed screw for the purpose of propelling the reproducing sound box across the record was dispensed with.

Q7. Had this construction of apparatus and method of using the same been in public use in this country prior to the date just mentioned by you, to your knowledge? A. No, it had not.

Q8. You may state briefly what you know about the commercial use of this invention embodied in claims 5 and 35, from the time that it was first placed upon the market by you, or by the United
720 States Gramophone Company, in 1894? A. In 1895 the United States Gramophone Company gave a sole license under the patents owned by it, to the Berliner Gramophone Company, of Philadelphia, and thereupon this latter company continued the manufacture and sale in large quantities of apparatus, such as described in the two claims mentioned, and from that time the business of selling these machines grew to large proportions, until to-day on every portion of the globe machines of this type can be found.

Q9. You may state whether prior to the time that 721
your invention involved in this suit, was placed upon the market, as stated by you, there was any other company or party manufacturing or selling, without your license on permission, a machine involving the apparatus and method of your invention? A. No, I have not parted with my rights for making and selling this invention to any other party, except to the United States Gramophone Company, who was the successor of the American Gramophone Company.

Q10. And you may state whether your invention embodied in the claims in controversy in this suit, had been in public use in this or any country for 722
more than two years prior to your application for this patent in suit, No. 534543? A. No, it had not.

Cross-examination by Mr. Mauro:

XQ11. In answering Q7, did you assume that "public use" is synonymous with "commercial use?" A. By "public use" I mean any other use but of my own and my assistants of the laboratory.

XQ12. According to your understanding, a use in public is not a public use if by yourself or one of your assistants. Is that your understanding? A. By public use I understand the use in public of an invention for profit.

XQ13. You say that the first sale of machines in 723
which a feed screw for the purpose of propelling the reproducing sound box across the record was dispensed with, occurred in 1894. Is it your understanding that the invention of the claims involved in this suit is for an apparatus or method for propelling a reproducing sound box across the record without a feed screw? A. The two claims, 5 and 35, refer to any apparatus in which the record groove both propels and vibrates the reproducing stylus or sound box, and it practically means to the exclusion of a feed screw for that purpose, or

724 of any other device outside of the record groove itself, by which the sound box or the reproducing stylus may be propelled across the record surface.

Redirect-examination by Mr. Pettit:

RDQ14. Were any of the machines claimed in claim 35 or apparatus embodying claim 5, in public use, in any sense, to your knowledge for more than two years prior to the date of your application for your patent in suit?

Objected to as incompetent.

A. No, they were not.

EMILE BERLINER.

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Deposition of the witness concluded.

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A Paper read Before the Franklin Institute, May 16, 1888, on the Gramophone, by its Inventor, Emile Berliner, Published by the U. S. Gramophone Company, Washington, D. C., Washington, Rufus H. Darby, Printer, 1894. 733

THE GRAMOPHONE: ETCHING THE HUMAN VOICE.

By Emile Berliner.

(A paper read at the Stated Meeting of the Franklin Institute, May 16, 1888.) 734

Jos. M. Wilson, President, in the chair.

The President introduced Mr. Berliner, who spoke as follows:

Members of the Franklin Institute, Ladies and Gentlemen:—The last year in the first century of the history of the United States was a remarkable one in the history of science.

There apeared about that period something in the drift of scientific discussions which, even to the mind of an observant amateur, foretold the coming of important events.

The dispute of Religion *versus* Science was once more at its height; prominent daily papers commenced to issue weekly discussions on scientific topics; series of scientific books, in attractive popular form, were eagerly bought by the cultured classes; popular lectures on scientific subjects were sure of commanding enthusiastic audiences; the great works on evolution had just commenced to take root out side of the small circle of logical minds from which they had emanated and which had fostered them; scientific periodicals were expectantly 735

736 scanned for new information, and the minds of both professionals and amateurs were on the *qui vive*.

Add to this the general excitement prevailing on acount of the forthcoming centennial celebration with its crowning event, so dear to this nation of inventors, the world's exhibition, and even those who did not at the time experience the effects of an atmosphere pregnant with scientific ozone can, in their minds, conjure up the pulsating, swaying and turbulent sea of scientific research of that period. Science evidently was in labor.

The year 1876 came, and when the jubilee was at its very height, and when this great city of Phila-
737 delphia was one surging mass of patriots filling the air with the sounds of millions of shouts, a still small voice, hardly audible, and coming from a little disc of iron fastened to the centre of a membrane, whispered into the ear of one of the judges at the exhibition, and one of the greatest of living scientists, the tidings that a new revelation had descended upon mankind, and that the swift and fiery messenger of heaven's clouds had been harnessed to that delicate, tremorous, and yet so potent form of energy, called the Human Voice.

The speaking telephone had been born.

The stimulus which this event gave to science can
738 best be measured by the enormous advance made since, especially in that new most prominent branch electricity; and I will show further on how, immediately following it, our sister Republic across the ocean answered the magic touch by the conception of another invention, the scope of which cannot today be measured yet, and which only just now is starting on its career of usefulness among the practical arts.

In order to show the influence which these two inventions had upon each other, and how their respective development came about in parallel steps,

permit me, before entering upon the new methods 739
which I am to bring before you to-night, to pass in rapid review on the principal events in the history of the transmission of speech electrically, and of recording and reproducing the same mechanically.

In 1854 Charles Bourseuil, with more than usual boldness, advanced the idea that two diaphragms, one operating an electric contact and the other under the influence of an electro-magnet, might be employed for transmitting speech over telegraphic distances. "Speak against one diaphragm," he said, "and let each vibration break or make the electric contact, and the electric pulsations thereby produced will set the other diaphragm vibrating, and 740
the latter ought then to reproduce the transmitted sound." Outside of the fallacy which his theory contained in the assumption of breaking the contact, instead of merely modifying the same, Bourseuil's paper, in speaking of the diaphragm, laid stress upon stating that "if one could be invented so movable and flexible as to answer to all the undulations of sound." He evidently desired extreme flexibility, and diaphragms constructed on that principle proved fatal to the efforts of many subsequent experimenters; even at first to Mr. Bell, who like Bourseuil, borrowed the idea from the flexible *typanum membrani* of the human ear, and who overlooked the important modifications which the 741
vibrations undergo, before reaching the auditory nerve, by the series of muscular hinges in which the various bony accessories of the ear are mounted and which act as elastic dampers against the *typanum membrani*.

Bourseuil's ideas were immediately reprinted from French journals in other countries, and among the first was a prominent German semi-weekly journal, printed in Frankfurt-on-the-Main. *The Didaskalia*, which, on September 28, 1854, under the heading "Electrical Telephony," published a

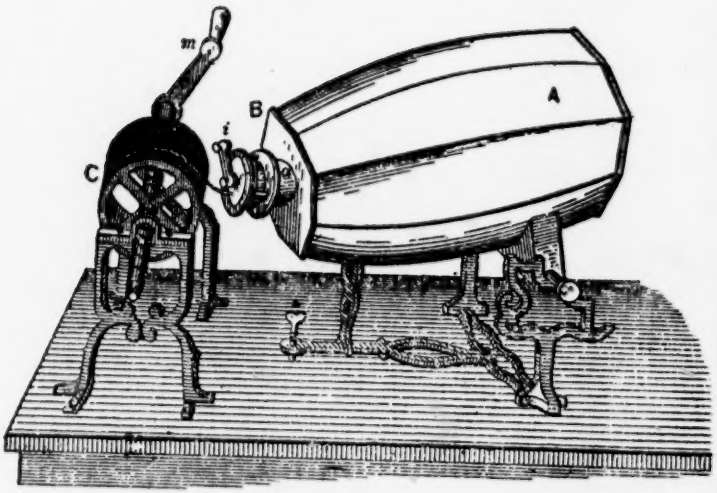
742 leading article, giving a full account of Bourseuil's ingenious and wonderful conception.

Franfurt was then a city of about 60,000 inhabitants, and among other institutes of learning, it supported a Physicial Society, which counted, at the time of this publication, among its active and most zealous members an enthusiastic young teacher named Philip Reis, who, five years afterward, actually made an apparatus such as indicated by Bourseuil (who had since died without executing his idea), and which apparatus has since become known as the Reis telephone.

I will not now enter upon any controversy as to
743 the scope of this invention, regarding the possibility, at the present day, to transmit speech with the same. It may suffice to state that, when the news of the Bell telephone reached the learned men of Germany, some of the very first scientists in Berlin, who knew all about the Reis apparatus, doubted the possibility of the performance as represented by the American press. It is also now a matter of history that in the late decision in favor of Mr. Bell the United States Supreme Court was unanimous so far as the Bourseuil-Reis apparatus was concerned.

744

FIG. 1.



Scott's Phonautograph.—1857.

While Bourseuil's conception was being digested by Reis, another invention, having also a membrane diaphragm as its motive principle, was patented in France in 1857. This was the phonautograph, by Léon Scott, which had for its purpose the recording of sound vibrations upon a cylinder rotated by hand and moved forward by a screw (Fig. 1). The cylinder was covered with paper, this was smoked over a flame, and a stylus attached to the center of a diaphragm, under the influence of words spoken into a large barrel-like mouthpiece, would trace sound vibrations upon the smoky surface. Scott also employed an animal membrane for his diaphragm, and took pains, by means of an attachment called a subdivider, to make the vibrations appear as large as possible. This subdivider,

748 however, became the prototype of the dampers in subsequent apparatus, like the Blake transmitter and the Edison phonograph.

The next important event in electro-phonic and acoustic science was the publication by Helmholtz of his investigations in sound, and of Konig in the same line of research; but, classical as these publications will forever remain, they for a time retarded the progress of apparatus for practical use, for the reason that they discouraged inventors by the mechanical complications which they apparently ascribed as indipsensable to articulate speech. In fact, the perusal of their work left a serious doubt
749 in the mind of many a student whether there was not something in articulate speech, and its audibility by the human ear, beyond the grasp of the mechanical mind of man.

These doubts were still increased by the attempts of Faber to construct a talking machine after the system of the human organs of speech, a mass of intricate mechanism—levers, bellows and pulleys—which gave an unearthly rendition of many words and sentences.

But the Bell telephone came, and its greatness consisted not so much in the fact that it carried speech over hundreds of miles, but that it taught how simple a piece of apparatus could produce such
750 perfect results, and that any diaphragm, however thick, could be made to set up audible articulate vibrations.

The effect of this lesson was immediate, for hardly had the new wonder become known when an astonishing chain of logic formed in the brain of a distant devotee to science.

On the 30th day of April, 1877, Mr. Charles Cros deposited with the Secretary of the Academy of

Sciences in Paris, a sealed envelope, containing 751
what in translation reads as follows:

"Process of Recording and of Reproducing Audible Phenomena."

"In general, my process consists in obtaining the tracing of the to-and-fro movements of a vibrating membrane, and the utilization of this tracing for reproducing the same to-and-fro movements, with their relative inherent durations and intensities in the same membrane, or in another adapted for furnishing the sounds and noises which result from this series of movements.

"We are, therefore, concerned with the transfor- 752
mation of an extremely delicate tracing, such as that obtained with a delicate stylus rubbing upon a surface blackened by a flame, to transform, I say, these tracings in relief or intaglio, in resisting material capable of guiding a moving body, which transmits these movements to the sonorous membrane.

"A light stylus is connected with the center of a vibrating membrane; it terminates in a point (metallic wire, the barb of a feather, etc.,) which bears upon a surface blackened by a flame. This surface is a part of a disk to which is given a double movement of rotation and rectilinear progression.

"If the membrane is at rest, the point will trace 753
a simple spiral; if the membrane vibrates, the traced spiral will be undulating, and these undulations represent exactly all the to-and-fro movements of the membrane, with their times and intensities."

Up to this point the apparatus as described would represent a modified Scott phonautograph, in which the cylinder is substituted by a flat disk. Mr. Cros then continues:

"By means of the photograhic process which, in

754 fact, is well known, this traced, transparent, undulatory spiral is converted into a line of similar dimensions, in intaglio or in relief in resisting material like tempered steel, for instance.

"This done, this resisting surface is, by means of a motor apparatus, made to turn and to progress rectilinearly with a velocity like that which was used in the registration.

"If the reproduced tracing is in intaglio, a metallic point (and if it is in relief, a notched finger), held by a spring, bears upon the tracing at one end and is connected at the other end with the center of the membrane adapted for sound reproduction. Under these conditions, this membrane
755 is not any more acted upon by the vibrating air, but by the tracing controlling the pointed stylus by pulsations exactly like those to which the membrane was subjected in recording, both as to duration and intensity.

"The spiral trace represents the successive equal periods by its increasing and decreasing length. There is nothing inconvenient in this if only the outer portion of the rotating circle is used, and if the spirals are close together, except that the central part of the disc is lost.

"In all cases, however, a helical tracing upon a cylinder is much to be preferred, and I am actually
756 engaged in finding a practical embodiment of this."

This paper was only read in open session at the Academy on December 3, 1877, and in the meantime Mr. T. A. Edison appeared with the phonograph.

From what we can learn by published reports. Mr. Edison, some time in the latter part of September, in the same year, was at work on an automatic telephone, by which he intended to impress a telephone message upon a strip of tinfoil and let the indentations thereby produced act upon a variable resistance, such as a lamp-black button, and

thereby transmit the message over the wire. While 757
one day at work on this, so the report runs, he perchance, slipped the previously indented slip under the recording stylus which, as in the Scott phonautograph, was connected to the center of a diaphragm, and then and there occurred the first actual reproduction by mechanical means of words registered before.

The phonograph became then, at once, an accomplished fact, for to such an experienced inventor it mush have taken but a moment to mentally cover the cylinder of a Scott phonautograph with tinfoil and to indent the same at right angles to the surface of the cylinder. 758

Everybody remembers the sensation which the invention produced, and the prognostications which were advanced for it by the scientific press showed that the principle of the apparatus was at that time considered to contain the grm of an ultimate achievement of more accurate results.

In this respect, as well as in others, there are striking resemblances in the history of the two inventions with which I am dealing.

In both, the original idea emanated from Frenchmen, and both described one process of transmitting, and a different process of reproducing speech. In the Bourseuil telephone there was a contact transmitter and an electro-magnet receiver; in the 759
Cros phonograph, a written record and an engraved reproducing groove.

In both inventions the first realization occurred in the United States, and was effected with apparatus representing only the reproducer of the original conception. In the speaking telephone, the reproducing electro-magnet of Bourseuil became also the transmitter of Bell, and in the phonograph the reproducing grooves, and stylus of Cros became also the record of Edison. Both the Bell and Edi-

760 son apparatus were accepted for a time as containing the best mechanical and philosophical principle for the highest attainable results. In both, the aim at the beginning was to produce loud sounds, and both eventually contented themselves with a much fainter voice, which then became more distinct in articulation. Finally, in both inventions, the original transmitter was subsequently resurrected and found to contain a pointer toward a superior principle as a transmitter and recorder, and it only remains now to use a Scott phonautographic record direct for reproduction in order to complete a parallel with the fact that a contact transmitter
761 can also be used as a telephonic reproducer.

In making these parallels, however, I am aware of the fact that Cros had a better conception of a talking machine than Bourseuil had of a speaking telephone.

The paper of Mr. Cros, which can be found on page 1082, Vol. 85, of the *Comptes Rendus* of 1877, appears to have been consigned immediately to obscurity. When, ten years later, I filed my patent application for the gramophone, not even the examiners at the Patent Office knew anything of Mr. Cros, and when I mentioned his name in the first publication of the "gramophone," even those best informed on the subject were surprised. Nevertheless, I considered it a duty to my friends to make
762 the following statement to the editors of *The Electrical World*, which they published simultaneously with the "gramophone," on November 12, 1887. I said:

"On August 30 of this year, which was three months after the filing of my application for a patent, while in the office of my counsel, Mr. Joseph Lyons, I happened to look through a German scientific book in his possession, and, reading up about the phonograph, I came across a remark stating

that on April 30, 1877, one Chas. Cros deposited at 763
the French Academy of Science a sealed paper, which, when opened and read at a subsequent session during that year, was found to contain a description of the author's idea that a photo-engraved phonautographic record, either in relief or intaglio, might be utilized for reacting through a stylus on a diaphragm, and by this reaction ought to reproduce the original sound."

"Surprised as I was at this discovery, I requested Mr. Lyons to find out through his frieds in Paris whether and to what extent Mr. Cros had ever carried his idea into practice, and an answer has since come to the effect that Mr. Cros never put his idea 764
into practical operation.

"Whether he was taken aback by the *eclat* which the phonograph produced soon afterward; whether he became discouraged at the practical difficulties, of which I have found many at the outset of all my experiments, or whether he did not appreciate the peculiar advantage of the phonautogramic method—all this does not appear from the meager accounts so far to hand.

"But although, viewed in the light of equity, he had virtually abandoned his invention at the time when I independently and without knowledge of his prior idea took up the same subject, the fact 765
remains that to *Mr. Charles Cros belongs the honor of having first suggested the idea of and feasible plan for mechanically reproducing speech once uttered.*"

As this statement has never been challenged since it was first made, I presume that it is substantially correct.

If we should attempt to carry out strictly the ideas of Mr. Cros we would find many obstacles to obtaining practical results, and while undoubtedly the correctness of the general principle could be

766 proved, the effects would not be as good even as those obtained by the original phonograph. Even with the application of the various improvements which I originally introduced, the process requires great care; and while this would not have been an obstacle, on account of the great advances made in photo-engraving, I have now abandoned the original process altogether, and have substituted one of great rapidity and simplicity.

But, to return to the phonograph, we find this apparatus remained in an unsatisfactory and unfinished condition for nearly nine years.

Among those who believed that ultimately it
767 could be turned to practical account was the well-known original patron of the speaking telephone, Mr. Gardiner G. Hubbard; and, being also financially interested in it, he, in 1883, or thereabouts, caused the Volta Laboratory Co., an association originally founded by Prof. Bell as a laboratory, from the funds of the Volta Prize awarded to him by the French Government, to provide ample funds for the purpose of making an extensive series of experiments with the phonograph.

Prominent among the scientists connected with the enterprise were Prof. Bell, Dr. Chichester A. Bell, and Mr. C. S. Tainter. After two years of ardent labors these gentlemen came to the conclu-
768 sions:

First. That the indenting process had to be abandoned and an engraving process be substituted, *i. e.*, instead of pushing the record surface down with the stylus, as in the original phonograph, it should rather be dug out or graven into.

Second. That the best substance, answering also the various other requirements, was beeswax hardened by an admixture of paraffine or other similar waxy substances.

Third. That loud speaking was impracticable, and 769
that the ordinary conversational tone gave better results, although reducing the reproduction to the loudness merely of a good telephone message.

In Patent No. 341214 of May 4, 1886, issued to Dr. Chichester A. Bell and Mr. C. S. Tainter, the following claims, among others, were granted:

"The method of forming a record of sounds by impressing sonorous vibrations upon a stylus, and thereby *cutting* in a solid body the record corresponding in form to the sound waves in contradistinction to the formation of sound records by indenting a foil with a vibratory style, etc.

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"3. The vibratory *cutting* style of a sound-recorder, substantially as described.

"7. A sound record consisting of a tablet, or other solid body, having its surface *cut or engraved* with narrow lines of irregular and varied form corresponding to sound waves, substantially as described.

"9. The method of forming a sound or speech record, which consists in engraving or cutting the same in *wax* or a *wax-like composition*, substantially as described."

As a final result of all their labors, there issued 771
in the Spring of 1887 the graphophone, the first really practical apparatus of the phonograph type, and which was exhibited to admiring crowds in Washington and elsewhere.

The record ground of this machine is a thin pasteboard cyclinder covered with wax.

Soon after the graphophone became generally known, Mr. Edison, evidently encouraged by the results obtained in this instrument, took again to experimenting with the phonograph, and, after trying wax covered with tin-foil for indentation, he abandoned that mode of recording, and also set-

772 tled upon a cylinder of wax and the graving out process, thus confirming the correctness of Bell and Tainter's conclusions, and the new Edison phonograph and the graphophone appear to be practically the same apparatus, differing only in form and motive power.

I now come to the subject of the evening, the Gramophone.

In my telephonic studies I had become familiar with all the causes influencing the transmission and reproduction of the voice, and what had at all times struck me as forcibly as anything in telephonic phenomena was the fact that the self-induction of
773 long iron wires or of polarized electro-magnets acted so detrimentally upon the articulation. Electrical resistance alone would simply have weakened the sound, but self-induction meant retardation, and this distortion of the transmitted waves which varied in length and amplitude. To appreciate fully what an extremely small amount of energy ordinary speech possesses mechanically let us consider a few well-known facts:

A puff of air, not strong enough to extinguish a candle-flame, when blown across an empty bottle or into a whistle will produce a sound which may be heard over a hundred feet away. The amount of electricity needed to operate audibly a magneto-
774 telephone is said to be less than one-millionth part of the electricity of a standard Daniel cell.

In considering such, and other facts, it became evident to me that if such delicate energy, subdivided into maybe several hundred waves, should indent or engrave itself into a solid body, it needed but very slight mechanical resistance to modify considerably the character of the sound vibrations: for what self-induction is to the telephone circuit the variable resistance which impressible material offers to indentation or engraving at various depths is to the phonograph record sheet. Neither

is proportional in direct ratio to the expended energy and must give cause, aside from a reduction in size of the sound characters, also to a distortion of the same. 775

Your o' n Prof. Houston, in his learned remarks in the Journal of the Franklin Institute of January, 1888, says:

"The difficulties just pointed out, it would seem, must exist in any instrument, however improved in its mechanical structure, if it makes the record on the Phonogram at right angles to the surface thereof. Of course, if a substance were discovered for such a surface that offered a resistance to indentation exactly proportional to the depth of such indentation the difficulty would, to a great extent, be removed." 776

All the experiments which were made with the phonograph and the graphophone confirmed the correctness of all these assertions; for the louder it was necessary to speak when recording, the less distinct became the articulation of the reproduced sound.

A change for the better was, therefore, to be obtained.

First. By tracing the vibrations, as in the old phonautograph, parallel to the record sheet. 777

Second. By reducing the resistance offered by the record medium to as near to nothing as possible.

Both principles, although not emphasized, are contained in the Cros document; but, for my part, I found that merely smoked surfaces were utterly impracticable, because if sufficiently black for a photo-engraving and with the extremely small sizes of waves obtained with records that are adaptable for the reproduction of good articulate speech, the record lines were ragged and, under a magnifying glass, looked like a set of parallel saws whose teeth

778 would form a grating sound which nearly drowned the articulation.

I observed, however, in my experiments that the grayish deposit of lamp-black, which is obtained from the center of a kerosene flame, was more oily and gave a somewhat sharper line than the deep black deposit caused by smoking with the top of the flame, and this led me to the highly beneficial process of oiling the plate prior to smoking the same, either by applying printers' ink or artists' paint by means of a printers' roller or by brushing oil over it. The smoke would then amalgamate with the oil and form a *fatty ink* of a rather dry
779 consistency, which, when crossed by a stylus, shows, even under a microscope, a sharply cut transparent line.

I still employ this process for small test-plates, and prepare them as follows: One part of paraffine oil is mixed with twenty parts of benzine or gasoline. This mixture is poured on and off a glass disk, when the benzine evaporates, leaving an extremely thin layer of oil. This is held over a smokey flame and moved to and fro until the surface looks just dry. The application of artists' paint with a roller prior to smoking is still better.

I also adopted for the gramophone a disk of glass as a support for the smoke deposit, traced the
780 sound record from below so that the displaced lamp-black should fall down, varnished it after the tracing was done, and used this disk as a negative without, therefore, needing a camera or photographic chemicals outside of the chrome-gelatine or chrome-albumen used in developing a raised picture. I would refer for a detailed account to the already mentioned issues of The Electrical World and the Journal of the Franklin Institute.

The lesson of simplicity which the telephone was continuously preaching caused me at an early day to look for a simpler plan to attain my purpose,

and in the specification originally filed by me I said: 781

"This record (meaning the phonautogram) may then be engraved either mechanically, *chemically* or photo-*chemically*." And, although for a long time without much hope for success, the purely chemical process of direct etching haunted me continuously, and was repeatedly suggested by others.

But it was easier suggested than carried out, because under the principles of the gramophone the etching ground was to offer practically no resistance to the stylus, and to make one which had no resistance mechanically, but did resist the etching fluid after the tracing was done, was the problem 782 to be solved.

You will readily see that if we can cover, for instance, a polished metal plate with a delicate etching ground, trace in this a phonautogram, and then immerse the plate in an etching fluid, the lines will be eaten in, and the result will be a groove of even depth, such as is required for reproduction. Such a process, of course, would be much more direct and quicker than the photo-engraving method.

In nature provision seems to be made for all the wants of mankind; and, confident in this belief, I kept on trying to find a trail which would lead to promising results, and I have the honor to-night, 783 for the first time, to bring before you this latest achievement in the art of producing permanent sound records from which a reproduction can be obtained, if necessary, within fifteen or twenty minutes, and which can be accurately multiplied in any number by the electrotype process. It may be termed, in short, *the art of etching the human voice*.

The etching ground which I use is also a fatty ink, and one of the best I have found thus far is made by digesting pure yellow beeswax in cold gasoline or benzine.

784 Benzine in a cold state will not dissolve all the elements of the wax, *but only a small part*—namely, that which combines with the yellow coloring principle—and the resultant and decanted extract is a clear solution of a golden hue, which gradually becomes bleached by exposure to light. The proportions which I use are one ounce of finely scraped wax to one pint of gasoline. The bottle containing the mixture must be repeatedly shaken, and, after the white residue has settled, the clear fluid is decanted or drawn off by a siphon.

I then take a polished metal plate—generally zinc—and flow the fluid on and off, as if I would coat with collodion. The benzine will quickly evap-
785 orate, and there remains a very thin layer of wax, iridescent under reflected light, not solid as a coating produced by immersion in a melted mass, but spongy or porous, and extremely sensitive to the lightest touch.

Partly on account of the too great sensitiveness of a single film, and also as an additional protection against the action of the acids employed in the subsequent etching, I may apply a second coating of the solution, and this double coat I find to answer all requirements.

The protection which this porous or spongy wax affords from the acid is mostly due to the fact that
786 watery solutions assume the spherical state on the film, while at the lines where the wax is distributed the acid enters freely and attacks the metal below.

A difficulty which only a short time ago appeared insurmountable, was the accumulation at the point of the stylus while tracing the sound record of filamentary particles of dust which exist in the wax solution, and which, being ever present in ordinary rooms, settle down and adhere to the film. These dust particules are so fine that they cannot, as a rule, be detected by the most searching inspection of the prepared plate; but they become very con-

spicuous and a very serious source of annoyance 787
when a long record is being made.

It must be borne in mind that the contact which the tracing stylus makes with the record surface is obtained by the elastic pressure from a piece of hair-spring backed by a narrow blade of writing-paper, and which pressure amounts to about five grains. Therefore, as this stylus passes through the fatty ink or other ground and traces the fine undulatory line, the dust particles, as well as small portions of the displaced ink or wax, adhere to and accumulate at the point of the stylus and are dragged along, and the record thereby becomes blurred and indistinct. 788

I have discovered an effective means for overcoming this difficulty, and it consists in applying to the record surface a fluid that slightly adheres to the etching ground and keeps it wet while the record is being made. I have found commercial alcohol to be very effective for this purpose, and it is used by pouring it over the plate just before the sound record is made. The alcohol, of course, immediately commences to evaporate, but not rapidly enough to disappear entirely before the record is finished, and there is no difficulty in adding more alcohol while the plate revolves. Under this condition the point of the stylus remains perfectly clean, and it seems as if the dust particles had not 789
been present at all.

The theory by which I explain this result, is that the alcohol, so to speak, lubricates both the surface and the stylus and prevents the adhesion of the filaments to the latter. At any rate, the application is highly beneficial, and the resulting line is so sharp and fine that it has to be widened in the subsequent etching process in order to permit the acid to bite at sufficient depth. It can also be proved that the resistance of the wax film is de-

790 creased by the presence of the alcohol; but when this has evaporated the wax film appears to be in precisely the same condition as before, even showing again the iridescent colors which disappeared on the application of the alcohol.

The film of wax being so thin it is almost transparent, and if the record were made on this it could barely be detected. As, however, it is sometimes desirable to examine the record prior to etching the same, I can smoke the etching ground slightly by holding it high above burning camphor, so as to prevent a heating and melting of the spongy wax, and the alcohol poured afterward over this smoked
791 surface does not seem to wash off any of the soot particles.

We now come to the important process of etching the record. Etching is done on steel, copper or brass with nitric acid, perchloride of iron, or with a mixture of muriatic acid and chlorate of potash, known as Dutch mordant. In modern photo-engraving nearly all the etching is done on zinc by means of diluted nitric acid, and these materials are preferred on account of their being cheaper than any other, and zinc is a metal easily obtained with smooth and even facings. In etching, however, on zinc it is necessary continually to brush away the hydrogen bubbles which
792 form and adhere to the lines, and as the etching ground is usually of firm and solid material (like asphaltum, hard wax, pitch, or rosin mixtures), no harm results from the brushing necessary in order to obtain sharp edges along the lines.

Desiring to avail myself of the advantages offered in zinc plates, I soon found that no etching fluid was known that would be to zinc what perchloride of iron was to copper, namely, etch cleanly and without the appearance of hydrogen bubbles. To apply the brushing to the delicate spongy wax film I employed was out of the question, as the first touch would wipe away the whole ground, and to

permit the formation of hydrogen bubbles without 793
brushing them away meant uneven and ragged lines and a distorted record.

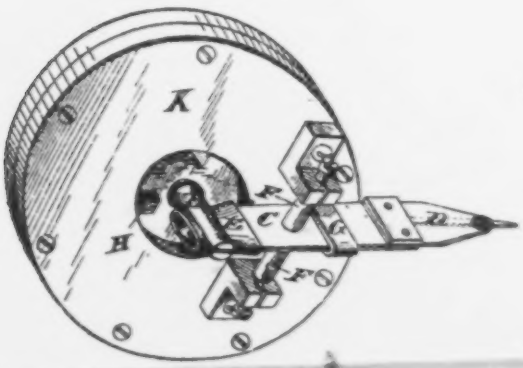
While studying this matter over it occurred to me to, so to speak, depolarize the zinc plate by adding to the acid bichromate of soda, which I thought might prove efficient, as it does in the galvanic battery, to prevent the appearance of the bubbles while etching the zinc. It took, however, a comparatively large quantity of the bichromate to answer my purpose—so much that I concluded that the mixture had all the conditions of a chromic acid, or at least of a mixture of chromic acid and nitrate of soda. When I thereupon substituted a solution of 794
chromic acid, pure and simple, I found this to be a most excellent etching fluid, and that is what I am now using—namely, a solution of one part by weight of dry chromic acid dissolved in three parts by weight of water. I use the commercial acid, such as can be obtained from Churchman & Co., of this city, at twenty-five cents a pound. Such a solution etches on zinc a sharp and clearly cut line and no hydrogen appears during the etching.

The back of the zinc plate had previously been painted with protecting varnish or molten beeswax and within from fifteen to twenty minutes from the time of immersion in the chromic acid solution, and 795
without disturbing it, a cleanly cut groove of sufficient depth is obtained for reproduction. This groove may then be deepened in the ordinary way of rebiting by covering the facing of the plate with rosin dust, heating the same, and then immersing in diluted nitric acid. Under these conditions the brush may be applied until the necessary depth is obtained, generally in about one to three minutes, according to the strength of the etching fluid. I have used stronger solutions of chromic fluid. I have used stronger solutions of chromic acid with no ill effects and a more rapid etching and there seems to be

a wide margin on this point, provided the plate is watched during the etching process. The lines very gradually widen when in the course of the etching, but the upper edges of the groove remain perfectly parallel and sharply defined.

Before proceeding with a practical demonstration of the whole process I will now describe the most important apparatus of the gramophone—the recorder. The translation of the movements of the diaphragm into the same movements at right angles, and with the extreme smallness of the motion and the liability of distorting them, adding to them, or detracting from their value in translating them, requires greater care to guard against error than an uninitiated observer would suppose, and when we examine the complex and extremely delicate mechanism which nature has provided in the human ear for giving a correct translation of air vibrations into nervous vibrations it behooves us to be careful in the application of everyday mechanics. Free as the telephone is, comparatively, from me-

FIG. 2.



chanical incumbrances, it is deficient in articulation of the consonants, and with the simplicity of mounting, as acquired in the phonograph and graphophone, these difficulties of recording proper do not exist, and are shifted to the other portions of their construction and manipulation.

In having attempted, therefore, to do justice to all sources of error, I am not yet prepared to say that my present recording apparatus is constructed and adjusted to the greatest attainable correctness. Those who are familiar with the tediousness of original research will admit that a new subject of this kind cannot be solved in its entirety within the space of a few months, and what I bring before you to-night, being the hasty results of a new machine finished but ten days ago, should be measured rather by the possibilities it opens than by the results so far attained, whatever merit you may accord to them.

My impression, however, is that there is very little of lost or added motion in my present apparatus and whatever imperfections may exist must be looked for in the mode of reproducing the sound rather than in the recorder (Fig. 2).

K is the diaphragm-box; A is the center portion of the diaphragm; B is a brass post screwed to the diaphragm and slotted above; E is a piece of rubber tubing held in the slot and holding one end of the stylus C. This stylus is made of stiff metal and is pivoted by the steel pivots FF. D is a blade of writing paper reinforced by a piece of hair spring, which extends and forms the tracing point. G is a piece of rubber around the stylus, which dampens its musical vibrations. H is a piece of felt damper between the diaphragm and the diaphragm-box, which acts as a general damping device.

802 The whole is mounted on a sliding carriage, which is drawn by clockwork across the disk, while the latter revolves at the rate of about thirty revolutions per minute.

DEMONSTRATIONS.

While the plate is being etched, I will now let you listen to some phonautograms which I prepared in Washington within the last two weeks. The reproducing apparatus or sounder is constructed on precisely the same principles as the recorder, but of smaller dimensions and more rigid mountings—so rigid, in fact, that if it were used as a recorder it would barely show undulations on a
803 smoked surface when shouting into it.

The stylus is tipped with iridium like points of a gold pen, the object of this being to prevent abrasion by the continuous friction with the hard record.

In reproducing the sound I find that it is louder with hard contact substances, like metal, than with soft ones, like rubber or plaster of Paris. Hard metals, like copper, nickel or brass, sound louder than zinc or type metal, but the scraping sound, which is due to friction, is also increased unless the record surface is smooth and very highly polished.

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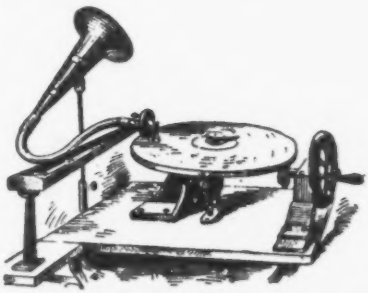
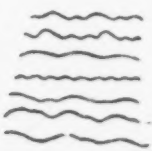
Recording Diaphragm and Stylus.—May, 1888.



Reproducing Apparatus.—May, 1888.



Record lines (magnified 6 diameters).

808 But when an iridium pointed stylus is rubbed over clean glass, a scraping sound is barely susceptible. I am now in communication with a firm that is making ornamental glass tiles by impressing upon red-hot glass plates fancy designs in relief or intaglio by strong pressure. You will readily see that if on the same plan we can impress a matrix showing the sound record in raised lines upon a glass plate, we would get a groove in glass giving a loud reproduction with a minimum of disturbing sound due to friction.

In the description of Nov. 12, 1887, I advanced the idea of mounting the sounder on a carriage and rails, and have the record-groove itself be the screw
809 which was to guide the point of the stylus across the disk from periphery to center. This has been improved upon by Mr. Werner Suess, the gentleman here with me to-night, and who is the mechanician of our little shop in Washington. He suggested to mount the sounder on a pivot at some distance from the disk and then let the reproducing groove guide the sounder across the disc over an arc of flat amplitude. This happy idea is embodied in the present apparatus, and is a very ingenious adaptation indeed.

PRACTICAL APPLICATIONS.

810 A standard reproducing apparatus, simple in construction and easily manipulated, will, at a moderate selling price, be placed on the market.

Those having one may then buy an assortment of phonautograms to be increased occassionally, comprising recitations, songs, chorus and instrumental solos or orchestral pieces of every variety.

In each city there will at least one office having a gramophone recorder with all the necessary outfits. There will be an acoustic cabinet, or acousticon, containing a very large funnel or other sound-concentrator, the narrow end of which

ends in a tube leading to the recording 811
diaphragm. At the wide opening of the funnel will be placed a piano, and back of it a semi-circular wall for reflecting the sound into the funnel. Persons desirous of having their voice 'taken' will step before the funnel, and, upon a given signal, sing or speak, or they may perform upon an instrument. While they are waiting the plate will be developed, and when it is satisfactory, it is turned over to the electrotyper or the moulder in charge, who will make as many copies as desired.

There is another process which may be employed. Supposing that the Holy Father should desire to 812
send broadcast a pontifical blessing to his millions of believers, he may speak into the recorder, and the plate then, after the words are etched, is turned over to a plate-printer, who may within a few hours print thousands of phonautograms on translucent tracing paper. These printed phonautograms are then sent to the principal cities of the world, and upon arrival they are photo-engraved by simply using them at photograph positives. The resultant engraved plate is then copied *ad infinitum* by electrotyping or moulding, and sold to those having standard reproducers.

Prominent singers, speakers or performers may 813
derive an income from royalties on the sale of their phonautograms, and valuable plates may be printed and registered to protect against unauthorized publication.

Collections of phonautograms may become very valuable and whole evenings will be spent at home going through a long list of interesting performances. Who will deny the beneficial influence which civilization will experience when the voices of dear relatives and friends long departed, and utterances of the great men and women who lived

814 centuries before, the radiant songs of Patti, Campanini, and others, the dramatic voices of Booth, Irving and Bernhardt, and the humor of Nye and Riley can be heard and reheard in every well-furnished parlor.

Last wills can be registered with the testators' own voices, and important testimony can be sent from afar and read in Court, and the voice so produced can be testified to by friends present.

Languages can be taught by having a good elocutionist speak classical recitations, and sell copies of his voice to students. In this department alone, and that of teaching elocution generally, an im-
815 mense field is to be filled by the gramophone.

Addresses—congratulatory, political or otherwise—can be delivered by proxy so loudly that the audience will be almost as if conscious of the speaker's presence.

A singer unable to appear at a concert may send her voice and be represented as per programme, and conventions will listen to distant sympathizers, be they thousands of miles away.

Future generations will be able to condense within the space of twenty minutes a tone picture of a single lifetime. Five minutes of a child's prattle, five of the boy's exultations, five of the man's reflections, and five from the feeble utter-
816 ances from the death-bed. Will it not be like holding communion even with immortality?

POSTSCRIPT.—One of the peculiarites inherent with the gramophone is the possibility to enlarge the original sound by enlarging the printed vibratory characters of speech and then photo-engrave the same. In this manner it should be possible to get the reproduction at a much greater volume than the original sound. It would be interesting if some day speakers in a large hall would prefer to do their

talking by machine, or to send speeches to a convention which they were unable to attend in person. 817

E. B.

(At the close of the paper and after the exhibition of the apparatus, Prof. E. J. Houston moved a vote of thanks to M. Berliner for his interesting and valuable communication. The motion was carried unanimously, and the meeting was adjourned.)

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Specification, Including Description and Claims on Application for Letters-Patent of the United States Covering the Mechanical Feed Device of the Talk-O-Phone.

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My invention relates to certain improvements in talking machines employing a disk record, and it has for its main object to provide positive mechanical means for propelling the reproducer carrying arm across the face of the record at a rate corresponding to the record grooves.

A further object is to provide means whereby the reproducer is rigidly locked against lateral movement in a direction outward from the center of the record so long as the stylus of the reproducer is in contact with the record; and also to provide means whereby it becomes necessary to raise the stylus out of contact with the record when the reproducer is moved across the face of the record.

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A further object consists in providing a simple and easily operated adjustment whereby the movement of this reproducer arm may be regulated and varied to adapt my invention for the use of the various makes of records.

In the ordinary forms of disk talking machines the reproducer carrying arm is capable of free lateral movement across the face of the record while the stylus of the reproducer is in contact with the record groove. This condition oftimes results in irreparable damage to the record, since the operator, through ignorance or carelessness, will sometimes force to move the stylus across the record grooves and thereby break down the walls of said grooves. Where my invention is employed it is imperative that the stylus be lifted from contact with the face of the record before the return movement of the reproducer arm can be accomplished.

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826 Of the various makes of disk records on the market, the American and Columbia are molded with approximately 100 undulatory grooves to the inch, the Victor and Zonophone with approximately 98 to the inch, and the Favorite and Leeds records with approximately 84 to the inch, so that it is apparent that if the reproducer arm and reproducer were propelled at an invariable rate of movement, the machine would be adapted for the use of one make of record only, or such records as have the same number of grooves to the inch. In my invention I provide means for varying the movement of the reproducer arm at will, the necessary adjust-
827 ment to adapt the machine for any make of record being readily accomplished.

In carrying out my invention, I employ the novel combination, arrangement and the details of construction hereinafter shown, described and particularly pointed out in the claims.

In the accompanying drawings Figure 1 is a plan view of a disk talking machine embodying my invention; Figure 2 is a side elevation of the same; and Figure 3 is enlarged elevation, partly in section, showing the means for imparting movement to the swinging reproducer arm.

Referring to the drawings, 1 is the casing of a talking machine adapted to contain a spring motor
828 of any ordinary or preferred construction, 2 being the vertical spindle of said motor extending through the top of the casing and adapted to carry the turn-table 2. Four indicates the swinging reproducer arm pivoted at one end at 5 upon a bracket 6 and having free vertical and lateral movement upon its pivot. At the outer end of the reproducer arm is mounted the reproducer 7 carrying the usual stylus 8 adapted to move across the face of the record and engage the record grooves; 9 is a bevel gear firmly secured upon the vertical spindle

2, and said gear meshes with a bevel gear 10 se- 829
cured upon a horizontally rotatable spindle 11 provided with a screw thread or worm 12 which engages a worm gear 13. Rotating with and fixed upon the worm gear 13 is a pinion 14 meshing with a gear 15 carrying a swinging arm 16, disposed below the swinging reproducer arm and swinging in a direction opposite thereto. The arrangement of the gearing is such that when the motor of the talking machine is operated and the turn-table spindle rotated at the usual speed, the rotation of the gear 15 and the arm 16 is so slow as to be nearly imperceptible. Arm 16 is of tubular construction, as plainly shown in Figure 3, and the same is provided 830
with an elongated slot to permit free movement along the same of a stem 18 extending downwardly from the reproducer arm. Stem 18 terminates at its lower in and enlargement at its lower end having the form of a ball nicely fitting the interior of the tubular arm 16. By this construction the stem 18 is permitted to slide along the tubular arm 16 with a minimum of friction, and the connection of the reproducer arm with the arm 16 is effected. Stem 18 is secured at its upper end to a block 19 adjustable mounted upon the reproducer arm at a point approximately midway between the ends of said arm, 831
said block being capable of adjustment away from or toward the pivot of said arm, a set screw 20 securing the block in any of its adjusted positions. Carried by the block 19 is a pointer 21 moving along a plate 22 secured upon the reproducer arm, and upon said plate are indicated, preferably by initial letters, the various makes of records, as plainly shown in Figure 2, there being vertical grooves beside the letters on the plate to locate the exact position to which the pointer is to be moved. The inner end of tubular arm 16 is pivoted to a

832 spring-pressed link 23, the same have a free vertical movement upon its pivot, as indicated in dotted lines "a" Figure 2, and being therefore free to vibrate in unison with the reproducer arm to adapt itself to unevenness in the record surface. Link 23 is in turn pivoted to a sleeve 24, loosely mounted to permit free movement upon a stud 25 which also supports the gear 15. Link 23 is provided with a downwardly projecting tooth 26 adapted to engage the teeth 27 of an annular ratchet 28 an upper face of the gear 15, being normally forced into engagement with said ratchet by a spring 29. Between the joined ends of the tubular arm 16 and
833 the link 23 is an angular space 29, so that, when the reproducer arm is raised to lift the reproducer from the record, the arm 10 will initially take the position in dotted lines "b," Figure 3. During this operation, the link 23 is still in engagement with the ratchet 28, the reproducer arm being consequently locked against lateral movement. When the arm 16 has attained the position "b," the angular space between the ends of the arm and the link will be closed, the ends being in close contact. Further lifting of the reproducer arm will raise the arm 16 above the position "b" and cause the link 23 to be disengaged from the ratchet 28, and said link being pivoted to the sleeve 24 which has a free
834 rotary movement upon the stud 25, the reproducer arm may be freely moved upon its pivot.

In the operation of my invention, we will assume that an American record is to be reproduced upon the machine. The block carrying the stem 18 is adjusted upon the reproducer arm to the position shown in Figure 2 and secured in said position, the exact point being indicated by the letter A upon the plate secured upon the arm. After starting the motor which propels the turn-table, the reproducer arm is raised and the stylus of the reproducer placed in the record groove. The operation of the

motor will actuate the tubular arm 16, causing the same to swing slowly in the arc "5," Figure 1, and positively propel the reproducer arm across the face of the record at a rate corresponding to the record grooves. By adjusting the block carrying the stem 18, to vary the distance of said block from the pivot of the reproducer arm, the rate of the movement of the reproducer arm may be made to correspond to the pitch of the grooves in the various makes of records. When the reproduction is completed, the reproducer is removed from contact with the record face by lifting the reproducer arm, and since, as, hereinbefore described, said arm must be raised to a considerable height above the record face before it can be returned to its original position, the possibility of damaging the record grooves is eliminated. 835 836

It will thus be seen that I provide means for locking the reproducer arm against the manual movement in a lateral direction while the stylus is in contact with the record, and that damage to the record is thereby insured against; and that I provide positive mechanical means for propelling the stylus carried by the reproducer across the face of the record in accordance with the record grooves; and further that I provide means whereby the rate of the movement of the reproducer arm may be varied to correspond to the pitch of the grooves in the particular record employed upon the machines. 837

Having described my invention, what I claim and desire to secure Letters Patent is—

1. In a talking-machine, a swinging reproducer arm, and a rotative non-supporting part connected with said arm to impart swinging movement thereto.

2. In a talking machine, a rotatable record disk a swinging reproducer arm, and a rotative non-sup-

838 porting part, connected with said arm to impart swinging movement thereto in accordance with the record grooves.

3. In a talking-machine, a rotatable record disk, a swinging reproducer arm, a rotative non-supporting part connected with said arm to impart swinging movement thereto in accordance with the record grooves, and means for varying the movement of said arm.

4. In a talking-machine, a rotatable record disk, a swinging reproducer arm, a rotatable non-supporting part connected with said arm to impart
839 swinging movement thereto in accordance with the record grooves, and adjustable means carried by said arm to vary its movement.

5. In a talking-machine, a swinging reproducer arm, a second arm mounted to swing below the reproducer arm and having operative connection therewith, and means for actuating said second arm.

6. In a talking-machine, a swinging reproducer arm, a second arm mounted below said reproducer arm and having a sliding connection therewith, and means for actuating said second arm.

840 7. In a talking-machine, a swinging reproducer arm, a second arm connected with the reproducer arm and mounted to swing below the same in a direction opposite thereto, and means for actuating said second arm.

8. In a talking-machine, a swinging reproducer arm, a slotted tubular arm mounted to swing below said reproducer arm a connection carried by said reproducer arm engaging the tubular arm through the slot therein, and motor-driven means for actuating said tubular arm to impart swinging movement to the reproducer arm.

9. In a talking-machine, a swinging reproducer arm, a tubular arm mounted to swing below said reproducer arm, said tubular arm having an elongated slot, a connection between the reproducer arm and the tubular arm comprising a stem extending through the slot in the tubular arm and having a ball-shaped end to traverse the interior of the tubular arm, and motor-driven means for actuating said tubular arm. 841

10. In a talking-machine, a swinging reproducer arm, a slotted tubular arm mounted to swing below said reproducer arm, motor-driven means for actuating said tubular arm, an adjustible block carried by said reproducer arm, means for securing said block in adjusted position, and a connection betwen said block and said tubular arm comprising a stem carried by said block and extending through the slot in the tubular arm and having a ball-shaped end to traverse the interior of said tubular arm. 842

11. In a talking-machine, a rotatable record disk, motor-driven means for imparting rotation to said disk, a swinging reproducer arm adapted to be impelled across the face of the record, and a rotative non-supporting part actuated by said motor-driven means and adapted to engage said reproducer and impart swinging movement thereto. 843

12. In a talking-machine, a rotable record disk, motor-driven means for imparting rotation to said disk, a swinging reproducer arm carrying a reproducer adapted to be impelled across the face of the record, a second arm mounted to swing below the reproducer arm and operatively engaging the same, and gearing connecting said second arm with the aforesaid motor-driven means.

13. In a talking-machine, the combination with the rotatable motor-driven record-supporting spindle, of a swinging reproducer arm, a second arm

844 mounted to swing below the reproducer arm, and connected therewith to impart swinging movement thereto, and gearing connecting said second arm with the aforesaid record supporting spindle.

14. In a talking-machine, a swinging reproducer arm mounted so as to be free to vibrate in a vertical direction, a motor-driven rotative arm mounted below said reproducer arm and also free to vibrate in a vertical direction, and a connection between said arms.

15. In a talking-machine, a swinging reproducer arm mounted so as to be free to vibrate in a
845 vertical direction, a motor-driven rotative arm mounted below the reproducer arm and also free to vibrate, and a downwardly extending stem carried by said reproducer arm having a sliding connection with said motor-driven arm.

16. In a talking-machine, a reproducer arm mounted to permit the same to be lifted manually, a motor-driven rotative part mounted below said arm, a swinging arm operatively connected with said reproducer arm and pivoted upon said rotative part, and means actuated by the lifting of the reproducer arm for disengaging said last named arm from said rotative part to permit free swing-
846 ing movement of the reproducer arm when the same is lifted.

17. In a talking-machine, a rotatable motor-driven record disk, a reproducer located above the record disk, a stylus carried by the reproducer adapted to contact with the face of the record disk, a supporting arm for the reproducer mounted to permit the reproducer to be impelled laterally across the face of the record, a rotative part actuated by the motor-driven means for the record, an arm carried by and rotative with said rotative part and having operative connection with said repro-

ducer arm, and an interengaging connection be- 847
tween said rotative part and the arm carried thereby, whereby the reproducer is held against manual movement in a lateral direction while the stylus is in contact with the record face.

CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*

vs. 848

TALK-O-PHONE COMPANY.

VICTOR TALKING MACHINE COMPANY, *et al.*

vs.

LEEDS & CATLIN COMPANY.

State and County of New York, ss.: 849

Albert L. Irish, being duly sworn, says: I am President and Treasuerer of the Talk-o-Phone Company and have been connected with that Company since the time of its organization. I have read the annexed affidavit of Harry Ensign, Superintendent of the Talk-o-Phone Company, and the statements therein made by said Ensign are to the best of my knowledge, information and belief correct and true. The Talk-o-Phone Company has never been engaged in the manufacture of sound records of any kind, and has manufactured only

850 talking machines without sound records. The Talk-o-Phone Company has from time to time bought and sold disc sound records and has put upon such disc sound records at times the label of the Talk-o-Phone Company, and the Talk-o-Phone Company has also bought and sold disc sound records having the label of the manufacturer or other label thereon.

I am acquainted with the course of business of the Leeds & Catlin Company, and I know that the Leeds & Catlin Company has never manufactured talking machines, but has manufactured sound records. Furthermore, the Leeds & Catlin Company has not been engaged in the purchase and
851 sale of talking machines, but the Leeds & Catlin Company took from the Talk-o-Phone Company a certain number of talking machines in settlement of an account. Other than talking machines so taken by the Leeds & Catlin Company from the Talk-o-Phone Company, the Leeds & Catlin Company has not purchased talking machines from the Talk-o-Phone Company, and I am informed and believe, and my knowledge and observation confirms the statement that the Leeds & Catlin Company has not purchased and sold other disc talking machines.

The Victor Talking Machine Company and its counsel have been sending to the trade letters such
852 as that dated March 6, 1906, by the Victor Talking Machine Company to the trade, and such as that dated March 7, 1906, by Horace Pettit to Messrs. J. P. Crotty & Company. The sending of such letters to the trade has caused irreparable damage to the Talk-o-Phone Company, causing a loss of tens of thousands of dollars to the Talk-o-Phone Company. I, therefore, instructed counsel for the Talk-o-Phone Company, Louis Hicks, to compel the Victor Talking Machine Company immediately to make its motion for preliminary injunction.

I have read the moving affidavits of Messrs.

Kennedy, Fagan and Middleton upon these two 853
motions for preliminary injunction in the above entitled suits. The statements contained in said affidavits that both in complainants' and defendants' machines and records, the machine is only capable of use in connection with a record of this description, and the record is only capable of use in connection with a machine of this description is incorrect and untrue. The records referred to are capable of use with machines of different description, for instance with the Talk-o-Phones, provided with feed mechanism and with talking machines manufactured according to the patents prior to the patent in suit, which talking machines have been 854
on the market for many years. Such sound records existed before the date of the invention of the patent in suit, as appears from defendants exhibits herein, and have continuously been used with machines of different types. In the affidavit of Mr. Kennedy, it is said that the main distinction of the invention of the patent in suit from the prior art is in the manner of propelling the stylus across the record without the aid or independently of any auxilary feed screw or other mechanism. Moreover, the talking machines referred to in the said affidavits may be used not only with disc sound records of the description set forth in the said affidavits, but may also be used with disc 855
sound records having vertical instead of lateral undulations, and with disc sound records of different types. In fact, there is no basis whatever for the statements referred to in the said affidavits mentioned. The sound records are capable of use and have been used with machines of various descriptions and existed before the invention of the patent in suit, and the machines are capable of use and have been used with records of various description, such fact being clearly apparent from the Edison early English Patent No. 1644, of 1878, as well as

856 from the early Bell & Tainter Patents. The record is no essential part of the machine and the machine is no essential part of the record. Each is and has been manufactured independently and each is and has been sold for export to countries foreign to the United States without the other, so that under no possible circumstances has there been within the United States in such instances a combination of the record and the machine or of the machine and the record. The export business of the Talk-o-Phone Company of Talk-o-Phones without records and the export business of the Leeds & Catlin Company of records without machines is large.

857 In addition to the Talk-o-Phone marked Exhibit A, which is manufactured by the Talk-o-Phone Company, as fully explained in the affidavit of Mr. Ensign, the Talk-o-Phone Company is making another type of talking machine, such as Exhibit B, herewith presented to the Court for inspection, upon which an application for a patent is also pending on behalf of the Talk-o-Phone Company. Talk-o-Phones, such as Exhibits A and B, and similar machines constructed along the lines of Edison's English Patent No. 1644 of 1878 and other patents prior to the date of invention of the patent in suit clearly do not and cannot infringe the patent in

858 suit. Obviously records made and sold for use on such machines are similar in all respects to records made and sold for use before complainants' machines were known or on the market and such records were made and used long prior to the invention of the patent in suit, as the early prior patents to Berliner and others show.

I have for several years past been actually engaged in the manufacture and sale of talking machines and am familiar with the construction and operation thereof and with the market therefor. The American Graphophone Company under

license from complainant, has sold without re- 859
striction as to the records to be used thereon in the United States tens of thousands of machines similar to complainants' machines and so has complainant. There are, therefore, in use within the United States tens of thousands of talking machines licensed by complainant for the reproduction of sound from suitable records, which records, as above stated were an article of commerce before the invention of the patent in suit. Judge Hazel states in his opinion that "*the broad claims in suit in my judgment cannot be restricted to a record of even depth, such as described in the specification.*" This means that the claims cover machines in com- 860
bination with records having *vertical* undulations of *uneven* depth which as defendants' exhibits of prior patents show are and were, before the date of invention of the patent in suit, made as *disc* and as *cylinder* records. Complainants' affiants, in their moving affidavits, omit this statement of Judge Hazel from the parts quoted by them from his opinion and do not refer to it, but, in spite of it and contrary to it, erroneously and untruly say that machines such as complainants' machines are adapted for use only with records such as those exhibited. There are several machines made and on the market in the United States, provided with swinging arms carrying a stylus free to be vibrated 861
and propelled by the grooves of vertical cylindrical records without any auxiliary mechanism or feed screw device. Mr. Leeds, in his second affidavit, explains this fully. It is, therefore, as reasonable to say that all vertically undulating records are made solely for use on machines coming under the claims of the patent in suit (5 and 35) as to contend that all records of even depth are made for such use.

No Talk-o-Phone ever manufactured, sold or used by the Talk-o-Phone Company was provided

862 with a recorder or reproducer such as those illustrated in Figures 4, 5, 6 and 7 of the patent in suit.

I agree with Messrs. Ensign, Leeds and Moeller that the apparatus shown in Figure 10 of Patent No. 564586 is impractical. No such device was ever put upon the market, so far as my information goes, and such a device could not be used for the successful reproduction of sound from a record.

The Talk-o-Phone Company has been advised by its counsel, Louis Hicks, that the patent in suit expired before the organization of the Talk-o-Phone Company by reason of the expiration of
863 prior foreign patents to Berliner for the same invention under Section 4887 of the Revised Statutes of the United States and relying upon that fact and law among other things the Talk-o-Phone Company has invested hundreds of thousands of dollars in its plant, factory and business and has not felt obliged to confine its manufacture of talking machines to those with mechanical feed devices such as Exhibits A and B, which the Talk-o-Phone Company has been making and largely advertising for sale since October, 1905. I annex hereto a copy of such an advertisement which appeared in The Music Trade Review for Dec. 2, 1905. Similar advertisements, showing the Talk-o-Phone with the
864 feed device have within the past six months appeared in more than twelve leading magazines and in newspapers throughout the United States, including the Pittsburgh Post, Pittsburgh Dispatch, Chicago Tribune, Chicago Record and Herald, Chicago Inter-Ocean, Cincinnati Enquirer, Philadelphia Record, Minneapolis Tribune, etc. For these advertisements the Talk-o-Phone Company has expended between $22,000 and $23,000 and has also expended large sums of money equipping its factory and plant for the manufacture of such

machines and has received large orders for such 865
machines which it is now in a position to fill.

The R. Wurlitzer Co. of Cincinnati and Chicago, Lyon & Healey of Chicago, Minnesota Phonograph Co. of St. Paul, Hayes Music Co. of Toledo, J. C. Crone of Cincinnati, Theo. F. Bentel Co. of Pittsburgh, Clark, Wise & Co. of San Francisco, and others have placed large orders with the Talk-o-Phone Company for machines such as Talk-o-Phones Exhibits A and B. The Theo. F. Bentel Co. writes as follows with reference to the Talk-o-Phone with mechanical feed mechanism:

The Theo. F. Bentel Co. Inc.

866

Everything in Talking Machines, Records and Supplies. Wholesale Distributors Edison Phonographs, American Talking Machines, Victor Talking Machines, Hawthorne & Sheble Laboratory Products, Edison's Laboratory Products, Kinetoscopes and Films, Etc.

Pittsburgh's Largest Talking Machine House.
632-634 Liberty Street.

Pittsburgh, Pa., March 5, 1906.

Mr. A. L. Irish,
President, The Talk-O-Phone Co.,
Toledo, Ohio.

867

My Dear Sir:

In compliance with your request for an expression from me as to the practicability of your new mechanical feed device, as applied to disc talking machines, I am pleased to say:

I have examined same carefully and from my nine years' experience in the handling of talking machines, from a manufacturing as well as a jobbing and retail standpoint, regard it as not only a practical but also an attachment that will fill a

868 long felt want and should appeal to all users of disc talking machines, as it must necessarily contribute very largely toward the removal of the only great objection to needle feed disc talking machines, namely, the scratch, together with the further fact that by the elimination of this objection, it also means the increased life of a disc record from 200 to 300 per cent.

From the quantity of your machines that we are using and in view of the above, you can readily see how glad we would be to see the adoption of this device at the earliest possible moment.

Wishing you continued success, I beg to remain,

Yours very truly,

869

Theo. F. Bentel.

A. L. IRISH.

Subscribed and sworn to before me this 5th day of April, 1906.

(NOTARY'S SEAL)

T. P. Dalton,
Notary Public,
Kings Co.

Certificate filed in New York Co.

870

A Wonderful Record Saver

A Marvelous Sound Reproducer is the New Taper Arm TALK-O-PHONE Equipped with the Ingenious Mechanical Feed

APPRECIATING that the grating, grinding noises of all disc reproducing machines are obnoxious, we have been experimenting for the past year to perfect a **Talk-o-Phone** that would be entirely free from all foreign sounds and only reproduce the pure musical tones.

We found that the dragging of the needle in order to propel the reproducer across the record was the cause of all the trouble. To obviate this we invented the **Mechanical Feed,** a disc to propel the reproducer across the record, entirely independent of the needle.

The marvelous, clear reproductions resulting from this new device must be heard to be appreciated. This, too, is a great record saver for there is no chance to scratch the needle across the record.

It will be observed that the **new Talk-o-Phone** operated on this principle gets entirely away from the old fundamental principle of reproducing machines, namely, the needle feed. Our patents on this new device are very broad, and this arrangement cannot be used on another machine. We do not operate under any shop rights or license from anyone.

Dealers selling reproducing machines should write immediately for our full descriptive matter and for prices on the **new Talk-o-Phone.** If you are interested in supplying your customers with the only machine which brings out from disc records the pure musical tone only, you must have a sample of this **new Talk-o-phone.**

874 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*,

vs.

TALK-O-PHONE COMPANY.

VICTOR TALKING MACHINE COMPANY, *et al.*,

875

vs.

LEEDS & CATLIN COMPANY.

State and County of New York, ss.

Edward F. Leeds, being duly sworn, says:

I have made another affidavit herein. I have read the moving affidavits upon these motions for injunction and the annexed affidavit of A. L. Irish of the Talk-o-Phone Company, whose statements therein are true to the best of my knowledge, in-
876 formation and belief. As stated in my foregoing affidavit, the Leeds & Catlin Company has never manufactured talking machines and has not been engaged in the purchase and sale of talking machines made by others except that the Leeds & Catlin Company in the settlement of an account with the Talk-o-Phone Company took a number of Talk-o-Phones in part payment. The business of the Leeds & Catlin Company is now and always has been the manufacture and sale of disc and cylinder sound records.

I have been in the talking machine business from its infancy. Disc sound records having lateral as well as vertical undulations were known and used before November 7, 1887, as appears from defendants' exhibits of prior foreign and United States patents. Before the date of the invention of the patent in suit disc sound records having lateral undulations were, therefore, known and used. The early patents for such records have long since expired. 877

The contention of the moving affidavit that disc sound records having lateral undulations can be used only on machines made according to Claim 5 and 35 of the patent in suit is untrue. Such sound records were used on other machines before any machine was made according to the alleged invention of the patent in suit set forth in claims 5 and 35. Berliner himself so states in his early foreign and United States patents and publications in evidence. Moreover, English patent No. 1644 of 1878 to Edison and the early Bell and Tainter patents show machines which can be used to reproduce sound records having lateral undulations. The Talk-o-Phones, Exhibits A and B, are such machines, which are constructed according to the feed mechanism of the early prior patents and not according to alleged invention of claims 5 and 35 of the patent in suit. 878 879

The contention of the moving affidavits that machines made according to Claims 5 and 35 can be used only with disc sound records having lateral undulations is likewise untrue. English Patent to Edison, No. 1644 of 1878, shows the contrary in figures 1 and 2. Judge Hazel, in his opinion, said that "the broad claims in suit in my judgment cannot be restricted to a record of even depth, such as described in the specification." Records of even depth are those having only lateral undulations. Hence, according to Judge Hazel and according to

880 the fact machines made according to Suess' invention, which is embodied in claims 5 and 35 of the patent in suit can be used with sound records having vertical undulations. I have myself operated such a machine for the reproduction of cylindrical sound records having vertical undulations. The machine had a swinging arm carrying a stylus at the free end which was vibrated and propelled across the surface of the record by the groove of the record, which, as above stated, was a record with vertical undulations on a cylinder. I saw half a dozen such machines in operation at 81 Franklin Street, New York City, on January 19, 1906, with
881 my counsel, Mr. Hicks. The machines were exhibited to me by a Mr. Nye, who wished to arrange with my company for the manufacture of cylindrical phonograph records for use therewith, the records to have vertical undulations similar to the ones then and there used with perfect success. I am informed and believe that the Jacob Music Company of 39 Union Square, New York, has a similar machine for use with similar records. It would, therefore, be as reasonable to say that all cylindrical or disc records having vertical undulations are designed for use only as the Suess machines embodied in claims 5 and 35 of the patent in suit. The fact is that sound records of every de-
882 scription antedate the invention of the patent in suit and were known and used on various machines prior to the invention of the patent in suit.

The Leeds & Catlin Company has purchased and used machines made by the complainant, Victor Company, and uses the same to-day. The Leeds & Catlin Company manufactures and sells for export and exports hundreds of thousands of disc sound records having lateral undulations and does not sell in connection therewith machines of any kind. The records of the Leeds & Catlin Company are

sold on the market without reference to the style 883
or character of machine with which they may afterwards be used and said records are adapted as above shown to be used with machines of different styles and are exported for use in foreign countries.

On November 2, 1905, at the Imperial Hotel in New York City, I saw the Talk-o-Phone such as Exhibit A, with a mechanical feed device in successful and perfect operation with records of different makes and I know that such machines have been extensively advertised for sale by the Talk-o-Phone Company.

In the United States, Berliner Patents in evidence, No. 372786 of November 8, 1887, and No. 884
382790 of May 15, 1888, have expired with the expiration of their seventeen year terms; and No. 564586 of July 28, 1896, has expired with the expiration of the terms of the prior English Patent No. 15232 of November 8, 1887, French Patent No. 186827 of November 8, 1887, German Patent No. 45948 of November 8, 1887. Furthermore the following Berliner foreign patents all prior to the patent in suit, have expired, viz.: English Patent 7294 of May 15, 1888; French Patents No. 193632 of May 15, 1888, and No. 207090 of July 19, 1890; German Patents of addition No. 47099 of May 16, 1888, and No. 53622 of November 20, 1889. All these expired Berliner patents describe and claim sound 885
records of even depth with lateral undulations and machines for making the same and reproducing sound therefrom. The claim made in the moving affidavits that the patent in suit can cover such sound record because of their possible use with the machines thereof is to my mind untenable. But as fully shown the patent in suit has also expired and the invention of claims 5 and 35 thereof belonged to Suess by his Canadian patent obtained on Berliner application, unless limited to the spe-

886 cial form of reproducer shown in figures 6 and 7, which has never been made, used or sold by the Talk-o-Phone Company or the Leeds & Catlin Company.

Relying upon this state of the art shown by the foregoing expired Berliner patents and by the expiration of all fundamental patents in the art, the Leeds & Catlin Company has invested and secured to be invested nearly a million of dollars in cash in its factory and plant for the manufacture of sound records of all kinds.

E. F. LEEDS.

Subscribed and sworn to before me
887 this 5th day of April, 1906.

T. P. Dalton,
[NOTARY'S SEAL.] Notary Public,
Kings County.

Certificate filed in New York County.

888

UNITED STATES CIRCUIT COURT, 889

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY vs. THE TALK-O-PHONE COMPANY.	In Equity.
VICTOR TALKING MACHINE COMPANY vs. LEEDS & CATLIN COMPANY.	In Equity. 890

State of New York, }
County of New York, } ss.:

Harry T. Goss, being duly sworn, deposes and says as follows:

I am thirty-three years of age, reside at Rutherford, New Jersey, and am by occupation a mechanical engineer and expert, having an office at No. 76 William Street, Borough of Manhattan, City of New York. I graduated from the Worcester Polytechnic Institute of Worcester, Mass., in 1894, and immediately thereafter entered upon the business of mechanical engineering and designing, in which business I have been constantly engaged down to the present time, and in which I have had occasion to give much attention to letters patent for inventions. I have had considerable experience in the art of recording and reproducing speech and other sounds, and in addition have been called upon to testify as an expert in cases growing out of infringement of letters patent. 891

892 My attention has been called to the recent suit of Victor Talking Machine Company vs. American Graphophone Company on Berliner Patent No. 534543, and, in that connection, to the Bell & Tainter Patent No. 341214, and Edison British Patent No. 1644 of 1878. What I have to say concerning these two patents will appear in this affidavit for the first time so far as I am aware, the same not being even suggested in the suit here referred to.

The leading difference, commented upon in the suit against the American Graphophone Company, between the feed of the Bell & Tainter graphphone
893 and that of the Berliner Patent grows out of the fact that in the former, although the sound-box is guided and propelled by the record-groove, this guiding and propelling does not extend over the entire surface of the record, that end of the reproducer arm distant from the sound-box being also moved by a mechanical feed. In the Berliner Patent, the sound-box is guided and propelled throughout its entire traverse by the record-groove. Apparently, therefore, the Court regarded the Berliner Patent as covering a structure in which the entire movement of the sound-box was due to the record-groove, but this I am satisfied from my examination of the structure of the Bell & Tainter
894 Patent was clearly understood by Messrs. Bell & Tainter, and in this I am confirmed by the deposition of one of the co-inventors, Chichester A. Bell, given in the suit brought in this Court, entitled "American Graphophone Company vs. National Gramophone Company," the deposition having been given on October 22d, 1900 (copy annexed, marked "Schedule A"), and by a paper deposited by Messrs. Alexander Graham Bell, Sumner Tainter and Chichester A. Bell in the Smithsonian Institute in October 1881, as appears by a copy thereof forming part of the record in the suit of American Grapho-

phone Company vs. American Record Company, 895
which case, brought in this Court, is now on appeal to the Circuit Court of Appeals for this Circuit.

In the paper so deposited and which has become known as the "Volta Laboratory Description," the inventors of the graphophone set forth the underlying features of that invention, showing such invention to include recording by means of either "a wavy or zigzag line of uniform depth" or "a straight groove of varying depth," and in this connection the following statement is made:

> "For some months previous to the present date (September, 1881) our invention has been practically perfected, but we still with- 896
> hold publication in the hope that our continued efforts may result in a more simple form of apparatus adapted for popular use."

To my mind this can mean nothing more than that the inventors were in search of a mechanism which was not only "simple" in the respect of having few parts, but also compact. From the form which the earliest graphophone took, as well as the several forms which have appeared from time to time during the exploitation of that machine, it is entirely apparent that the controlling thought was to get the machine within as small compass as possible. Had the sound-box of the graphophone 897
been fed the entire length of the record by means of the record-groove, this would have necessitated a long reproducer-arm pivoted at its distant end and the space consumed by the entire machine would practically have been doubled. The shorter arm provided with a mechanical feed for the distant end thereof was, and is, in my belief, the mechanical equivalant of Berliner's longer arm pivoted at its distant end, the former rather than the latter being adopted solely for compactness and in the effort

898 to produce the "simple form of apparatus adapted for popular use."

This conclusion, although to my mind an obvious one, is not merely matter of opinion or surmise. On the contrary, I find in the deposition of Dr. Bell ("Schedule A," annexed) evidence bearing directly upon the point (see Questions 8 *et seq*). He shows that during the work done by Mr. Tainter and himself "the groove cut in the wax was made to carry the reproducing style across the record," and that

> "I found that while that arrangement worked very well with a long lever it was not
899 quite satisfactory when the lever was made as short as I wished to make it to keep the size of the instrument within reasonable limits, and therefore some feed mechanism was added to the instrument so as to make the reproducer roughly (?) follow the motion of the record."

It is entirely clear to me that in view of the disclosure of the Edison British patent above referred to both of these methods of mounting the sound-box of a talking machine were open to Bell & Tainter at the date of the application for Patent No. 341214. Said Edison patent, in several of its fig-
900 gures and in the description concerning the same, discloses the use of a sound-box mounted upon a pivoted arm, but conected with this arm was another having a connection with a guide-groove. Examples of this construction are best shown in Figures 1, 2, 6 to 8 and 11. The sound-box (called by Edison the "phonet") included a stylus, and the record (called by Edison the "phonogram") is shown and described as being formed in tablets of various shape, including a "disc" and a "cylinder." The record-groove (see the foot of page 2 of specifi-

cation) was either straight or "zig-zag." In this 901
patent Edison describes and illustrates not only the feature of guiding the sound-box by means of a groove independent of the record-groove, but also the feature of guiding the sound-box by means of the sound-record groove itself. Probably the best illustration of this latter feature will be found in Figure 34, and in order to make this clear to the Court I have caused to be prepared a model which is presented herewith, marked "Exhibit Model Edison British Patent." Here the record-groove is formed in a disc the undulations or "indentations," as Edison called them, being spirally formed on both sides of such disc, and there being two sound- 902
boxes, one for each side, and suitably mounted so that after one has traversed the full length of the record-groove the other is brought automatically into engagement with the record-groove on the opposite side. Referring to this construction, the specification (p. 8) says:

> "Fig. 34 is a perspective view showing a double phonet, there being a spiral line of indentations on each side of the revolving disc *d*, one phonet coming into action as the other finishes; in this case the spirals should be in opposite directions, so that the disc continuing to revolve in the same direction 903
> *moves one phonet from the center outwards*, and then the other phonet is connected and moved back toward the center; this may be used as a toy."

In this construction, each of the sound-boxes is mounted upon a long arm, and these arms are pivoted at their distant ends to a block upon a rock-shaft. There is no mechanical feed whatever; in fact, absolutely nothing for guiding and propelling the sound-box save the record-groove itself.

904 The structure disclosed is precisely that of the Berliner patent, save that, instead of having a single sound-box and long pivoted arm, there are two such sound-boxes and arms and means for automatically bringing these alternately into engagement with the record-grooves on both faces of the disc.

The "Exhibit Model" herewith produced is a true and faithful reproduction of the structure illustrated in Figure 34 of the Edison patent. For compactness the rock-shaft on which the sound-box-carrying arms are mounted is made somewhat shorter, and in addition, for convenience of operation, a small crank has been put upon the end of the
905 shaft carrying the record disc. These are, of course, wholly immaterial on the question of disclosing the actual construction of the Edison device, as well as on the question of identity of the structure of his patent and that upon which the Claims 5 and 35 of the Berliner patent are based.

Claims 5 and 35 of Berliner Patent No. 534543 read as directly and certainly upon the Edison construction as they do upon that actually disclosed in the Berliner specification and drawing. Claim 35 covers the combination of "a traveling tablet having a sound-record" and "a reproducing stylus shaped for engagement with said record and free to
906 be vibrated and propelled by the same." The most casual glance at the Edison device will at once indicate the truth of the statement above made, these two instrumentalities being present in said device just as they are in the device of Berliner. The tablet has a "sound-record formed thereon" and the reproducing stylus is "shaped for engagement with said record and free to be vibrated and propelled by the same." There is, in fact, nothing else designed to vibrate or propel the reproducing stylus, or capable of vibrating or propelling that stylus, than the "sound-record"

formed in the "travelling tablet." This being true, 907
it necessarily follows that the method specified in Berliner's Claim 5 is practised in the operation of the Edison device, there being, in fact, no operation of that device save that which is specified in said claim and in which the sound-record vibrates the stylus and propels "the same along the record by and in accordance with the said record."

In so far as the Edison device is designed to employ a record tablet having a record-groove on both sides thereof, this constitutes a departure—a most immaterial one—from the mechanism disclosed by the Berliner Patent, wherein the record tablet has a record on one side only. For a number of 908
years past, however, the use of "double-cut" records has been very common, the same tablet bearing a record of one selection on one side and another record of another selection on the other. In reproducing these records in the modern machines, the sound-box is made to engage the record on one side of the tablet, and then when that reproduction has been finished the tablet is turned and the record on the other side brought into engagement with the sound-box. Edison's apparatus went farther than this, making it possible to double the length of the reproduction by providing means whereby, as the reproduction from one record was finished, another sound-box was automatically brought into engagement 909
with another record, such records being however, as is common to-day, on opposite sides of the same tablet.

HARRY T. GOSS.

Subscribed and sworn to before me, }
this 5th day of April, 1906. }

I. McIntosh,
[SEAL.] Notary Public,
N. Y. & Westchester Cos.

910 **Schedule A.**

IN THE CIRCUIT COURT OF THE UNITED STATES,

FOR THE SOUTHERN DISTRICT OF NEW YORK.

AMERICAN GRAPHOPHONE COMPANY vs. 911 NATIONAL GRAMOPHONE COMPANY and Frank Seaman.	In Equity No.

Testimony in reply for complainant taken pursuant to annexed notice before Reeve Lewis, a notary public in and for the District of Columbia, at the office of Philip Mauro, Esq., No. 620 F. Street, Washington, D. C., under and in accordance with Sections 863,864 and 865 of the Revised Statutes of the United States in such case made and provided, beginning at 10:30 A. M., October 22nd, 1900.

Present—PHILIP MAURO, Esq., for Complainant.
912 GUSTAV BISSING, Esq., for Defendant.

And thereupon Dr. Chichester A. Bell a witness produced on behalf of Complainant, being first duly sworn, deposes and says in answer to interrogatories propounded by Mr. Mauro, as follows:

Q1. Please state your name, age, residence and occupation?

A. Chichester A. Bell; of lawful age; residence, Richmond, Surrey, England; occupation physicist.

Q. Are you the C. A. Bell named as one of the

grantees of U. S. Letters Patent No. 341,214 913
granted May 4th, 1886, for Recording and Reproducing speech and other sounds?

A. I am.

Q3. Please state where and when the inventions described and claimed in that patent were made?

A. They were made in the Volta Laboratory in Washington between 1881 and 1885.

Q4. Do you mean that the work extended over the period mentioned in your last answer, or merely that the inventions were made between those dates?

A. The work extended pretty well over the whole period.

Q5. Please state who composed the Volta Laboratory Association and for what purpose it was organized? 914

A. Alexander Graham Bell, Sumner Tainter and myself; and it was organized for the purpose of making inventions. After its organization we decided to confine our work mainly to improvements in recording and reproducing sound.

Q6. The specification of your Patent No. 341,214, after describing the reproducer mounted on a universal joint, states that such reproducer so mounted is specially adapted for use in connection with a record in the form of a groove with sloping walls, and the form of record particularly described in said patent is one of varying depth; 915
please state whether the Volta Laboratory Associates prior to the application for said patent were familiar in practice with any other form of record and if so, with what form?

A. Yes, we made a great many experiments with records in the form of zig-zag lines, cut out in waxy substances, and with similar records etched in metal; and we found that our reproducer worked as well with those as with the records of varying depth.

Q7. State briefly the operation of making records

916 of zig-zag form by etching in metal as practiced by the Volta Laboratory associates?

A. Those experiments were made mainly by Mr. Tainter and by Mr. A. G. Bell. The vibrating style was arranged so as to cut a zig-zag line on a waxy surface or to cut a zig-zag line in a thin layer of waxy substance spread on metal, the surface of the metal being subsequently etched by well known processes. Sometimes we used galvanizing and sometimes etching fluids.

Q8. Were you or not, prior to the application for Patent No. 341,214 aware of the capacity of the record groove in various form of records made by
917 you to feed the reproducing stylus laterally across the record, and if yea, state how such familiarity was acquired?

A. Yes, I was perfectly aware of that, as the result of a great number of experiments in which the groove cut in wax was made to carry the reproducing stylus across the record.

Q9. If the result of that work gave you a preference for a particular mechanical form of apparatus, please state the reasons that determined such preference?

A. I found that while that arrangement worked very well with a long lever it was not quite satisfactory when the lever was made as short as I
918 wished to make it to keep the size of the instrument within reasonable limits, and therefore some feed mechanism was added to the instrument so as to make the reproducer rougly follow the motion of the record.

Q10. As a matter of fact, would a short lever follow the record to some extent?

A. Yes, it would; but you couldn't rely on it always to remain in the groove.

Direct-examination closed.

Cross-examination by Mr. Bissing: 919

XQ11. Will you please tell me what direct share you had in the preparation of the application on which the patent in suit was granted. I mean to ascertain whether you personally consulted the gentleman who drew the application, whether you left that to your co-inventor Mr. Tainter, or whether perhaps you sent a written draft of instructions to your solicitor instead of calling personally upon him.

A. I believe I had a great many personal communications with the gentleman who drew up the specification; I don't remember drawing up any written statement; I believe the communications 920 were all oral.

XQ12. About what time, so near as you can now remember, did you reach results with your records cut in wax, I mean your vertically undulating cut wax records, which convinced you that the cut wax record was a success and, if perhaps not ready just at that time to be put upon the market was yet the type of record which you proposed to push?

A. Very early in 1881, in fact it was before the Volta Laboratory Association was actually formed.

XQ13. Were your experiments with the laterally undulating records made at an earlier or a later date? 921

A. I don't like to speak positively on that point for the simple reason that I myself have not made many experiments of that kind, but my impression is that experiments of that kind were made very shortly afterward by Mr. Tainter.

XQ14. What was the object of making experiments on laterally undulating records, at a time when the vertically undulating cut wax record had been decided upon by you to have been a success and to be the record which you proposed to push?

A. Of course we had to make experiments to find

922 out the best form and to make perfectly certain on that point, and that could only be done by experiments; in fact we tried everything we could think of whether it seemed promising or not. Our specification does not include anything like the number of experiments we made.

XQ15. Is it not a fact that you obtained very much better results with your vertically undulating cut wax record than with any laterally undulating etched record you ever experimented with?

A. My recollection is that it was very hard to distinguish one from the other as far as results went, but the vertically undulating record was found in
923 every way, to be the most convenient, and that's why we adhered to it.

XQ16. Do you happen to remember the exact mode of preparing the particular laterally undulating etched record which gave you the best results?

A. I don't think I would like to speak positively on that point. Of course you will understand that that was not my department. This section of the work was done chiefly by Mr. Tainter.

XQ17. Mr. Tainter is alive to-day is he not?

A. I have not seen him for many years.

Counsel for Complainant states that according to his latest information Mr. Tain-
924 ter is alive, and that it is the intention of Counsel for Complainant to examine Mr. Tainter as a witness in this case.

Cross-examination closed.

RDQ18. How did the zig-zag cut record compare as to results with the cut record of varying depth?

A. Well, when the undulations were not too pronounced they gave very much the same results.

CHICHESTER A. BELL.

[SEAL.] Reeve Lewis,
Notary Public,
District of Columbia.

CIRCUIT COURT OF THE UNITED STATES, 925

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

TALK-O-PHONE COMPANY,
Defendant.

926

VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

State and County of New York, ss.:

Albert L. Irish, being duly sworn, says:

927

I am President and Treasurer of the Talk-o-Phone Company and have made a prior affidavit herein, verified April 5, 1906. I have read the affidavit of Robert L. Thomae, which is based, not upon knowledge, but upon alleged information, without stating the sources of the information. The financial standing and character of the Talk-o-Phone Company has been fully set forth in the affidavit of Ensign, but I desire to say that the Talk-o-Phone Company has invested Seven hundred thousand dollars ($700,000) in its business, and is strong

928 financially. Thomae's statement that the business of the Company has been conducted for the past few years under several names is untrue. The business of the Company has been conducted solely under the name of the Talk-o-Phone Company, and the stockholders and persons interested in the Talk-o-Phone Company are not those who were interested in any prior company. The Talk-o-Phone Company when incorporated was a new and independent company organized by new and independent interests. The Talk-o-Phone Company, it is true, took over the business of the former Ohio Talking Machine Company. Thomae's statement
929 that the Talk-o-Phone Company manufactures only one type of talking machine is untrue. The different kinds of talking machines manufactured by the Company have already been fully described in the answering affidavits. The Talk-o-Phone Company does not manufacture records of any kind. The statements contained in the advertisements of the Talk-o-Phone Company referred to by Thomae are truthful statements. The business done and to be done by the Talk-o-Phone Company is large and profitable and will continue so to be unless complainants wrongful and threatening statements to the trade are continued. The Talk-o-Phone Company has manufactured and sold talk-
930 ing machines in great numbers and the list of names of the concerns to whom talking machines have been sold by the Talk-o-Phone Company is a truthful list in said advertisements. What relevancy all this has to the issues involved in these suits I am unable to see. The obvious purpose of Thomae is to attempt to prejudice the Talk-o-Phone Company by reason of statements made without knowledge or reliable information. Thomae's statement that the mechanical feed Talk-o-Phones are gotten up merely as an attempt to evade the patent in suit and that the mechanical feed performs no

function, is clearly untrue. This matter has been fully discussed in defendants' answering affidavits. 931

The Talk-o-Phone Company has no connection whatever with the Leeds & Catlin Company and has purchased no records or other goods from the Leeds & Catlin Company for the last nine months at least. During the past nine months the Talk-o-Phone Company has purchased no records from any concern for sale, but has devoted itself solely in the manufacture and sale of talking machines. No one interested in the Talk-o-Phone Company is interested in the Leeds & Catlin Company, and no one interested in the Leeds & Catlin Company is interested in the Talk-o-Phone Company, and no person is employed by the Talk-o-Phone Company who acts for both companies. The two companies are entirely independent, separate and distinct. As stated in the annexed affidavit of Mr. Leeds the connection of Mr. Leeds with the Talk-o-Phone Company at the time of the organization of the Talk-o-Phone Company was merely nominal and continued for a month or so until the permanent organization of the Company was effected. I fail to find in the moving affidavits upon either of these motions any proof of title in the complainants to the patent in suit. 932

ALBERT L. IRISH.

933

Subscribed and sworn to before me this 13th day of April, 1906.

T. P. Dalton,
Notary Public,
Kings County.

[NOTARY'S SEAL.]

Certificate filed in New York County.

934 CIRCUIT COURT OF THE UNITED STATES,
SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

TALK-O-PHONE COMPANY,
Defendant.

935 VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

State and County of New York, ss.

Edward F. Leeds, being duly sworn, says:

I am President of the Leeds & Catlin Company and have heretofore made two affidavits herein, each verified April 5, 1906. I have read the affi-
936 davit of R. L. Thomae and do not understand the relevancy of his statements to the issues involved in either of the above entitled suits. Thomae's attempt to lead the Court into the belief that some connection exists between the Talk-o-Phone Company and the Leeds & Catlin Company is most surprising, since I believe that not only Thomae but counsel for complainants know fully that no connection whatever exists between the Talk-o-Phone Company and the Leeds & Catlin Company. The Leeds & Catlin Company has not sold records to the Talk-o-Phone Company for nearly a year last past, and, as already stated, the Leeds & Catlin Company never purchased machines from the Talk-

o-Phone Company except a few which it took in 937
part settlement of an account. No one interested in the Leeds & Catlin Company is interested in the Talk-o-Phone Company, and no one interested in the Talk-o-Phone Company is interested in the Leeds & Catlin Company, and neither company has any interest in the other company and no person employed by or acting for the one company is employed by or acts for the other company. At the time of the organization of the Talk-o-Phone Company in January, 1904, I was requested to become President of that company, by reason of my long experience in the talking machine business, but this I was unwilling to accede to. However, I was elected President of the company, notwithstanding my protests 938
and I sent in my resignation shortly thereafter. I never paid for any stock in the Talk-o-Phone Company and never saw any stock of the Talk-o-Phone Company issued to me, and never had any stock of the Talk-o-Phone Company issued to me in my possession and I do not now own or hold any stock or interest whatever in the Talk-o-Phone Company. If the Talk-o-Phone Company issued any stock to me for the purpose of having me elected President, the same stock was never turned over to me and was merely a formal transaction of which I have no knowledge. The Court should understand that the 939
Leeds & Catlin Company and the Talk-o-Phone Company absolutely and unconditionally represent different interests in no way connected. I fail to find in the moving affidavits upon either of these motions any proof of title in the complainants to the patent in suit.

E. F. LEEDS.

Subscribed and sworn to before me
this 13th day of April, 1906.

E. K. Van Beuren,
[NOTARY'S SEAL.] Notary Public,
Kings County.

Certificate filed in New York County.

940 **Affidavit.**

City of Washington, }
District of Columbia, } ss.:

Joseph Lyons, being duly sworn, deposes and says: I am and have been a solicitor for patents for many years past, and in that capacity I have, in behalf of Emile Berliner, of Washington, D. C., prepared and filed an application for Letters Patent of the Dominion of Canada, for an improvement in "Gramophone," and the papers hereto annexed are a true copy of the application, petition, oath, specification and drawing as prepared and filed by me with the Commissioner of Patents at Ottawa,
941 Canada, on December 7th, 1895, with the exception of the dates and signatures, which are left blank in the copy hereto annexed. The official filing receipt for said application is also hereto annexed. The application above referred to was never amended or changed in any way or manner prior to the grant of the patent. The patent was granted under No. 55079, on February 24, 1897, and was delivered to me and by me to the said Emile Berliner.

The Canadian Patent No. 55079 was intended to have, and I believe has the same specification and drawing as the U. S. Patent to Emile Berliner, No. 534543, granted February 19, 1895.

942 I am informed and believe that the original document is now in Canada.

JOSEPH LYONS.

Sworn to and subscribed before me }
this 12th day of April, 1906. }

[NOTARY'S SEAL.] Edwin S. Clarkson,
Notary Public,
D. C.

All communications should be addressed to the 943
Commissioner of Patents, Ottawa. When writing on this subject refer to No. 71661. Circular No. 1.

Department of Agriculture, Patent Office, Ottawa, Canada, 9th December, 1895.

Sir:

I have the honor to acknowledge receipt on the 7th instant of the Petition, Oath, Specification & Drawings applying for a Patent in favor of E. Berliner for "Gramopones," also the sum of Twenty dollars and to inform you that the papers have been filed and will meet with due attention, as soon as 3d copy of claims shall have been received 944
by this office.

I have the honor to be, Sir, your obedient servant,
R. Pope, Deputy Commissioner of Patents.
To J. Lyons, Esq., Washington, D. C.

Petition.

To the Commissioner of Patents, Ottawa:

The petition of Emile Berliner, of the City of Washington, in the District of Columbia, United States of America, electrician, showeth:

That he has invented new and useful improvements in Gramophones not known or used by others 945
before his invention thereof, and not being in public use or on sale; with his consent or allowance as such inventor for more than one year previous to his application for a patent in Canada.

Your petitioner therefore prays that a Patent may be granted to him for the said invention, as set forth in the specification in duplicate relating thereto, and, for the purposes of the Patent Act, your petitioner elects his domicile in the City of Ottawa, Province of Ontario.

And your petitioner hereby appoints Joseph

946 Lyons of No. 1003 F. Street, North West, Washington, D. C., U. S. A. his attorney, with full power of substitution and revocation, to prosecute this application, to sign the drawings, to receive the patent and to transact all business in the Patent Office connected therewith.

Signed at Washington, D. C., this day of 1895.

In the presence of

947

Oath.

City of Washington, } ss.:
District of Columbia, }

I, Emile Berliner, of the City of Washington, in the District of Columbia, United States of America, electrician, make oath and say, that I verily believe that I am the inventor of the new and useful improvements on gramophones, described and claimed in the specification in duplicate relating thereto and for which I solicit a patent by my petition dated day of 1895. And I further
948 say that the several allegations contained in the said petition are respectively true and correct.

Sworn before me at the City of Washington, D. C., U. S. A., this day of , 1895.

Specification.

949

To all whom it may concern:

Be it known that I, Emile Berliner, of the City of Washington, District of Columbia, United States of America, electrician, have invented certain new and useful improvements in gramophones, and I do hereby declare that the following is a full, clear and exact description of the same.

Reference is made to the accompanying drawing in which:

(Note: See stipulation, p. 541, Paragraph Third, as to the balance of this Canadian patent down to and including the signature "Emile Berliner." The Exhibit after the said signature concludes with the words set forth below.)

950

Washington, D. C.,
November , 1895.

Signed in the presence of

951

952 UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*

vs.

TALK-O-PHONE COMPANY.

THE SAME

953 vs.

LEEDS & CATLIN COMPANY.

On Motion for Preliminary Injunctions.

TOWNSEND, C. J.:

The bills allege infringement of claims 5 and 35 of the Berliner Patent, No. 534543. The Circuit Court for the Southern District of New York in the suit of this complainant against the American
954 Graphophone Company, after an exhaustive discussion of the issues presented sustained said claims and its decree was affirmed by the Court of Appeals on March 1st, 1906, after elaborate argument by able counsel and upon voluminous briefs in which apparently every material defence was presented and discussed.

The case on this motion is presented by some five hundred pages of affidavits and briefs; "Defendants' Exhibit Letters Patent" is a book of some 135 pages.

It appears that the machines of these defendants

are practically identical with those found to in- 955
fringe in the former suit. These defendants, however, have set up twelve defences claimed either to consist of new matter not before the Court on the former hearing, or to relate to matters which, while in the record at the former hearing were not considered or discussed. The Court is urged to dispose of these questions at the earliest possible moment in view of the great financial interests involved, and the advertisements and circulars issued by the respective parties relating to the patent in suit and the machines claimed to infringe, and of the serious damage involved whether a preliminary injunction be granted or denied.

956

The new defences are founded, *inter alia*, on the contentions that the patent in suit has expired by reason of the expiration of prior Berliner, German, French and English patents and a Berliner-Suess Canadian patent; by reason of Berliner's abandonment of his invention in view of said Berliner-Suess patent; that Berliner was anticipated by an Edison patent; that in the former suit the Berliner patent was not fairly in controversy; that complainant has been guilty of laches, and that defendants do not infringe in view of the prior art and especially of certain prior Berliner patents.

The first and second defences rest upon prior 957
Berliner German Patent No. 53622 and French Patent No. 207090. It is claimed that the Berliner patent in suit covers improvements in details of construction upon the Gramophone described and claimed in earlier patents, because his broad invention had been disclosed therein and especially in 372786 not before the Court in the original suit, and that those details were covered by said prior foreign patents; that the inventions in suit are identical with those of the foreign patents, and that as they expired prior to the commencement of this

958 suit, the patent in suit expired at the same time under the settled rule.

Bate Refrig. Co. vs. Sulzberger, 157 U. S., 1.
Siemens vs. Sellers, 123 U. S., 276.

It is claimed that the language of the specifications of the patent in suit supports this view where the patentee says that "one feature of my invention has reference to the method of recording sound" etc., and "the other features of my invention have reference to the construction of the details of both the recorder and the reproducer of the Gramophone," and that while he illustrated his reproducing ap-
959 paratus as a whole he does not state that it is his invention.

It is claimed further that unless the claims in suit are limited to certain improvements in details they are anticipated by Edison and Suess.

It is argued that the patent in suit expired prior to the commencement of this suit by reason of the expiration of said prior Berliner German and French patents. The drawings of the German patent are substantially identical with Figures 6 and 7 of the patent in suit and the specifications describe and the claims cover these constructions. The same is true, (barring the claims which are
960 immaterial) of said French patent.

The German patent being a patent of addition to prior Patent No. 45048 expired with the expiration thereof on November 7, 1902. The French patent expired July 19, 1905.

The French patent and the claims of the German patent cover improvements in details of the construction of Berliner's recorder and reproducer.

It is claimed by complainant that these details differ in construction and operation from those shown in the patent in suit and covered by claims not in issue, but this question can only be deter-

mined by expert testimony and this point does not 961
appear to be material in the determination of the issue herein.

The issue here presented, assuming the details to be substantially identical, is whether the prior patenting in a foreign country of a minor part of a broad or basic invention, such as that covered by the claims in suit, so affects the whole that the expiration of a foreign patent terminates the whole of a United States patent which includes both the minor parts and the broad main invention. The Circuit Court and the Circuit Court of Appeals in the original suit held that the claims in suit covered the broad invention. 962

The claims in suit are as follows:

> "5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same along the record by and in accordance with the said record, substantially as described.
> 35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described."

963

The statute provides as follows:

> "Section 4887. No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously

964 patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years."

The test in each case, under the statutes, is whether the inventions are identical, as is said by the Supreme Court in Commercial Mfg. Co. vs. Fairbanks Co., 135 U. S., 176-194.

"A fair test of the question as to whether the American patent is anticipated by the
965 foreign patents, or is included in them, we think would be; were a person in this country, after the issue of the present American patent, to commence the manufacture of oleo-margarine by the precise process described in the Bavarian or Austrian patents, supposing that process had not been patented abroad, would the courts refuse an injunction to restrain the use of the process on the ground that it infringed that covered by the American patent? We can hardly deem it possible that any intelligent court would deny an injunction if applied for under such circumstances, and we think this fairly il-
966 lustrates the relation of the foreign to the American patent."

The cases cited do not satisfactorily settle this question or at most do not seem to support defendants' contention. Thus in Siemens v. Sellers, 123 U. S., 276, the Supreme Court held that the American patent expired with the foreign patent, saying that "the principal invention is in both, and if the American patent contains improvements this fact cannot save the patent from the operation of the law which is invoked."

In Western Electric Co., vs. Citizens' Tel. Co., 967
106 F. R., 215, the Court said as follows:

> "But, what is more directly to the point, the essence of the patent in suit contained in the first claim thereof, namely, the cutting out of the annunciator from the circuit employed for conversation, is embodied in the description of the invention in the foreign patents. The construction given in the specifications necessarily involves it. The case is, therefore, brought under the operation of the rule laid down in Siemens' Adm'r. vs. Sellers, 123 U. S., 276, 8 Sup. Ct., 117, 31 L. Ed. 153, even though it be conceded that 968
> there are differences in some details between the foreign and the home patents upon which independent claims might be based."

I fail to find in the numerous cases cited by counsel any authority for the proposition advanced by defendant that if an article made according to the description of the prior foreign patent would infringe any claim of the American patent no matter how insignificant, then the two patents are for the same invention and the American patent expires *in toto* with the prior foreign patent. In fact the interpretation placed by the Courts upon the decision of the Supreme Court in Siemens vs. 969
Sellers, *supra*, seems to be that the test is whether the principal invention of the domestic patent is found in the prior foreign patent.

I think, from such brief examination as I have been able to give the authorities cited that the rule contended for by the defendant does not apply to cases where the foreign patents which have expired do not cover the broad claims for the basic invention.

It is next contended that the patent in suit expired at the same time with certain other Berliner

970 German and French patents and an English patent, because these patents cover the invention of Berliner's United States Patent No. 564586. But an examination of the drawings of the prior British patent shows that there is omitted therefrom the Figure 10 of the United States Patent No. 564586, which was the only figure illustrating the form of the device covered by the claims here in suit.

There is nothing either in the specifications or drawings of the said British patent which describes, illustrates or shows the method or apparatus of the claims here in suit. These considerations apply equally to said earlier German and
971 French patents.

The fourth, fifth and sixth defences are founded upon a Canadian patent (No. 41901) to Berliner as assignee of Suess, upon which defendant lays great stress. This patent discloses and broadly claims the invention covered by the claims here in suit. It is contended that thereby Berliner admitted that Suess was the inventor of the reproducing apparatus in suit; that by Berliner's application as assignee of Suess he abandoned the broad claims in suit, and that as the said Canadian patent covered said broad invention and expired in 1899, the patent in suit expired with it.

The evidence introduced in the original suit
972 showed and the Court found on the Suess Patent 427279 that Suess was merely an improver of a particular form of swinging arm device and some of the language used in the specifications of this Suess Canadian patent, which, however, was not before the Court in the original suit, seems to indicate that its structure is merely an improvement on the broad Berliner invention, and Berliner himself afterwards applied for and obtained a Canadian patent for the broad invention covered by the claims here in suit.

But the Canadian patent in terms describes and 973
claims the broad generic invention of Berliner covered by the claims here in suit, as will be seen from the following claims:

> "5. In an apparatus for reproducing sounds from a record tablet, the combination with a reproducer mechanism consisting of a sound conveying tube and a diaphragm and stylus mounted at one end of the tube; of a freely swinging supporting frame for the said reproducer mechanism, substantially as described.
>
> "7. In an apparatus for reproducing sounds from a record tablet, the combination 974
> with a reproducer mechanism consisting of a sound conveyer, and a diaphragm and stylus mounted at one end thereof; of a supporting frame for the said reproducer, loosely pivoted to swing freely both laterally and vertically, substantially as described.
>
> "11. In an apparatus for reproducing sounds from a rotating record-tabet, a reproducing stylus mounted to have a free movement over the surface of the record tablet, substantially as described."

I think, therefore, that if this patent expired as
claimed in 1899 the patent in suit expired at the 975
same time, upon the authority of the decisions cited above.

It is contended by complainant, however, that the Canadian patent did not then expire because it was granted for a term of eighteen years from its date, namely, from February 11, 1893. The grant of the patent is for "The period of eighteen years from the date * * * subject to the conditions in the Acts" of Canada. The patent grant further provides as follows:

> "The partial fee required for the term of

976 six years having been paid to the Commissioner of Patents, this patent shall cease at the end of six years from date unless at or before the expiration of the said term the holder thereof pay the fee required for the further term or terms as provided by law."

The rule in such cases as I understand it is that the duration of the United States patent is limited by the duration of the legal term of the foreign patent and that it is not limited by any lapse or forfeiture of any portion of said term by means of any condition subsequent.

977 Pohl vs. Brewing Co., 134 U. S., 386.

In Bate Refrig. Co. vs. Sulzburger, 157 U. S., 508, the Supreme Court says as follows:

> "But the American patent will be granted upon the condition that, if you obtain the foreign patent first, your invention shall be free to the American people whenever, by reason of the expiration of the foreign patent, it becomes free to the people abroad."

In Bonsack Machine Co. vs. Smith, 70 F. R., 383, the Court construing the decisions held that the question in every case was when does the foreign
978 patent expire looking to its language when issued. Applying this test here I conclude with some hesitation that as the term fixed in the grant was for eighteen years, at the time when the United States patent in suit was issued, the latter does not lapse at the end of six years because of the failure of the patentee after the United States patent had issued, to pay the fee for a further term of six years. This conclusion seems to accord with that reached by the Circuit Court of Appeals for this Circuit in Welsbach vs. Appollo, 96 F. R., 332. In any event, for reasons hereafter stated, I have concluded to

resolve the doubt raised on this point in favor of 979
the complainant.

The defence founded on the prior Edison patent will not be discussed because said patent was before the Court in the original suit. The contention that by reason of a certain contract between the parties "the prior suit was not * * * a suit in which the Berliner patent in suit * * * was fairly in controversy" is not deserving of notice. The contract and the relations of the parties were fully before the Court and the record and briefs in said case are a sufficient answer to any such contention.

The other defences of laches and non-infringement 980
need not be considered.

I have given all of my time available during the past ten days to the examination of the various questions presented on this motion and have reached the conclusion that, except as to the Suess Canadian Patent No. 41901 the defendants have failed to introduce any new matter which would in my judgment have led the Courts to reach a different conclusion if it had been before them in the original suit. But even if I am mistaken in this view, and if the expiration of the Suess Canadian patent is a complete defence or if a decision of the questions raised as to the character and scope of the various patents now introduced for the first 981
time should be postponed until final hearing, yet I am constrained to grant the injunction in order to permit an appeal and a determination of the questions at the earliest possible moment.

The motion for a preliminary injunction is granted with leave to defendants to move for a stay pending the decision of these questions by the Circuit Court of Appeals.

Filed April 26, 1906.

982 At a stated term of the Circuit Court of the United States for the Southern District of New York, held in the Court room thereof in Post Office Building, in the Borough of Manhattan and City of New York, this 2d day of May, 1906.

Present—Hon. WM. K. TOWNSEND,
U. S. Circuit Judge.

983 VICTOR TALKING MACHINE COMPANY and United States Gramophone Company,
Complainants,

vs.

LEEDS & CATLIN COMPANY,
Defendant.

Decree for Preliminary Injunction.
In Equity, No. 8797.
On Patent No. 534,543.

Complainants' motion for preliminary injunction having come on to be heard before me on April 6, 1906, and the argument having been opened and then adjourned to April 13, 1906, at the request of complainants to afford to complainants' cousel an
984 opportunity to examine and consider the affidavits and exhibits offered on behalf of defendant, and the said motion having been argued before me on April 13, 1906, by Horace Pettit, counsel for complainants, and Louis Hicks, counsel for defendant; due deliberation having been had,

Upon the affidavits and exhibits filed on behalf of the complainants, including Canadian Patent No. 55079 offered by complainants in rebuttal on April 13, 1906, and upon the affidavits and exhibits filed on behalf of defendant, it is.

Ordered: That a Writ of Preliminary Injunction issue in this cause, restraining the defendant, the Talk-o-Phone Company, its associates, servants, clerks, agents and workmen, and each and every one of them, from manufacturing, using, or selling, until further order of this Court, sound reproducing apparatus or devices embodying the subject matter of Claim 35, of the Letters Patent in suit, which claim reads as follows, namely: 985

> "35. In a sound reproducing apparatus consisting of a travelling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described." 986

And from manufacturing, using or selling, or in any way disposing of apparatus or devices which embody the method specified in Claim 5 of Letters Patent in suit, which claim reads as follows, namely:

> "5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same along the record by and in accordance with the said record, substantially as described." 987

And from using or employing in any way the method specified in said Claim 5.

W. K. TOWNSEND,
United States Circuit Judge.

Filed May 2, 1906.

988 UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

In Equity Case No. 8797.

VICTOR TALKING MACHINE COMPANY, *et al.*,
Complainants,

vs.

989 LEEDS & CATLIN COMPANY.
Defendant.

Ordered, this second day of May, 1906, that the writ of preliminary injunction granted by decree of even date be stayed pending the decision of the Court of Appeals, provided an appeal from said decree be promptly perfected; provided further that the defendant enter security in the sum of Ten thousand dollars ($10,000) to indemnify the complainants for damages and profits due to infringement accruing during the period of said stay, said
990 security to be approved by the Clerk of the Court, and to be entered within ten days from date, otherwise preliminary injunction to issue.

W. K. TOWNSEND,
United States Circuit Judge.

Filed May 2, 1906.

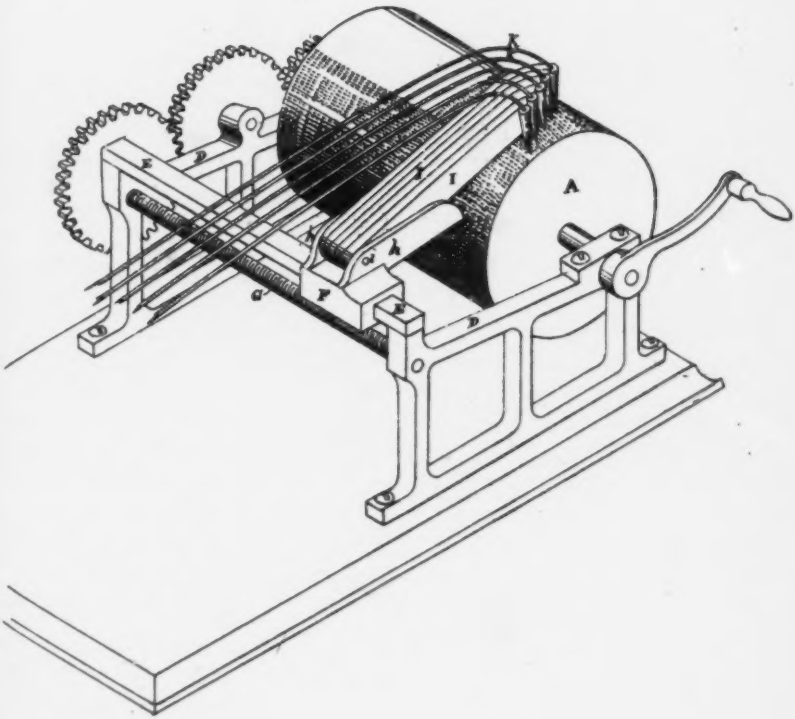
DEFENDANT'S EXHIBITS, LETTERS PATENT OF THE UNITED STATES AND ENGLAND.

331

L. PICKERING.

COPYING-TELEGRAPH.

No. 191,464. Patented May 29, 1877.



Witnesses

Geo. H. Strong

Jno. L. Boone

Inventor

Lewis Pickering

By Dewey & Co

their Attys.

UNITED STATES PATENT OFFICE.

LORING PICKERING, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN COPYING-TELEGRAPHS.

Specification forming part of Letters Patent No. **191,464**, dated May 29, 1877; application filed April 24, 1877.

To all whom it may concern:

Be it known that I, LORING PICKERING, of the city and county of San Francisco, and State of California, have invented a Typographical Transmitter for Automatic Telegraphs; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings.

My invention relates to a novel method of converting type-forms and other raised or engraved characters into transmitting-plates, so that, by causing the contact point or points of one or more telegraphic wires to traverse their surfaces in parallel and approximate lines, I can automatically transmit the matter represented by said forms or plates to distant stations, where the letters or characters can be reproduced by a suitable recording-instrument.

The principal object of my invention is to enable me to convert newspaper and other like forms of printing-types or engravings into telegraphic transmitters in a cheap, simple, and convenient manner, so that a fac-simile copy of the newspaper or other matter can be automatically transmitted over telegraphic wires in a speedy and convenient manner.

As the faces of the types used in newspaper-printing are usually quite small when compared with the types heretofore used in automatic telegraphy, a peculiar arrangement or adjustment of the contact-points is necessary, where several wires are used, in order to permit the several points to trace, in lines sufficiently close together to reproduce the outline of each letter.

My method of arranging these points in order to accomplish the object mentioned, together with the manner of preparing and operating my improved typographical transmitter, is more fully set forth and described in detail in the following specification, in which reference is made to the accompanying drawings, in which—

Figure 1 is a perspective view of my device.

Preliminarily, I will state that my invention can be applied to either flat or curved type-forms. In either case, the method of preparing the plate is the same.

For the purpose of this specification I have, in the present instance, represented a curved form applied to a cylinder, A, as hereinafter described.

To prepare my transmitting-plate, I take a printer's form, such as is set up in ordinary printing-type for printing upon a printing-press, and prepare from it a stereotype fac-simile in the ordinary manner of preparing stereotype-plates. I then fill the space in the plate between the types with some non-conducting material or substance, so as to insulate the faces of the types from each other and render the surface smooth and even. If the type-form is curved, such as is used on a cylinder-press, I secure it upon the cylinder A before applying the filling of non-conducting substance, and then, by rendering the surface of the material smooth and level with the faces of the types, so as to expose the faces, the cylinder is ready to be mounted in the frame D.

A filling of shellac or any other non-conducting substance of the consistency of putty, such as can be applied readily either warm or cold, will answer, and it is well, after the filling has been completed and the surface leveled, to sandpaper or otherwise polish or clean the surfaces of the type, to free them from any adhering portion of the substance. The type-plate can then be put in circuit by connecting one of the battery-wires with it, or it may be preferable to construct the cylinder A of copper, and allow its shaft to bear in the metallic frame D. Then, by insulating the frame the wire can be connected with it, so that the copper cylinder and the type-plate will be brought into the circuit.

It will be evident that I will now have a metallic type-plate in which the surfaces of the type are exposed in regular order, just as the types were originally set up, and with which it is only necessary to make the proper connections, to transmit a fac-simile copy to the opposite end of the contact wire or wires.

E is a horizontal bar, which extends across the frame D parallel with the cylinder A, and at a short distance from it. A slide, F, is arranged to be moved along this bar by means of a screw, G, which extends across the frame just below the bar E. The upper side of the slide is formed with two lugs or sides, *h h*, at a short distance apart, between which I place one end of each of several parallel arms, I I I,

and secure them by a shaft, i, which passes through the lugs or sides h h, and also through the ends of the arms. The opposite or free ends of these arms will then rest upon the cylinder A, one a little in advance of the other, as hereinafter described. The free end of each of these arms will then adjust itself to any inequalities on the face of the cylinder, independent of all the other arms.

The shortest arm on one side of the series may be straight, or preferably provided with a very slight curve at its outer end. The outer end of the next arm is slightly curved, so as to carry its extremity nearly in front of the first arm. The third arm is curved a little more, so as to bring its extremity nearly in front of the second, and so on, for as many arms as are used. This will cause the extremities of the several arms to stand in an oblique or spiral direction with reference to the surface of the cylinder.

K K K are the circuit-wires, as many being used as there are arms I. Each of these wires is provided with a platinum point, and the end of each wire is passed through a proper hole in the end of one of the arms, so that its point will project below the arm, and in this position the wires are secured and insulated from the arms by any suitable non-conducting filling placed around them in the holes.

Now, as the cylinder is rotated, the contact-points of the wires K K K will move over the surface of the cylinder and be fed slowly by the screws G from end to end of the cylinder, so as to come in contact with every part of the type-faces. The electric circuit will be completed in each wire every time its contact-point touches the metallic face of one of the types, and the circuit will be broken when the point touches the intermediate filling of non-conducting material.

A single wire or any number of wires can be used. I prefer, however, to use a number of wires, and a corresponding number of contact-points, so as to accomplish the transmission more speedily.

For receiving the telegram, I mount a drum at the opposite end of the lines, which will carry the chemically-prepared paper upon which the letter of the typographical transmitter is to be recorded by chemical decomposition in the ordinary manner of recording characters by the automatic telegraph system, or an arrangement could be applied for recording with ink or pencil. The recording-cylinder I will make larger in diameter than the transmitting-cylinder, and provide the two cylinders with a synchronal movement, so that the characters or letters will be enlarged at the receiving end of the line.

I thus provide for transmitting, in a simple and convenient manner, typographical engraved or other raised matter, so that a facsimile copy of the matter represented by the types can be speedily reproduced at a distant station.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method of converting forms of printing-types into transmitting-plates for telegraphic purposes, consisting in filling between the faces of the types, either in the original form or in a stereotype cast taken therefrom, a non-conducting substance that will, at the same time, insulate the faces of the types and provide a smooth level surface for the contact-points of the wires to pass over, substantially as and for the purpose described.

2. The hinged arms I I I, arranged to carry the points of the wires K K K in their free ends, in combination with the slide F and feed-screw G, substantially as and for the purpose described.

3. The arrangement of the contact-points of the several parallel wires of an automatic telegraph apparatus in an oblique or spiral manner, substantially as and for the purpose described.

In witness whereof I have hereunto set my hand and seal.

LORING PICKERING. [L. S.

Witnesses:
JNO. L. BOONE,
FRANK A. BROOKS.

T. A. EDISON.

334 Phonograph or Speaking Machine.

No. 200,521. Patented Feb. 19, 1878.

Fig. 1.

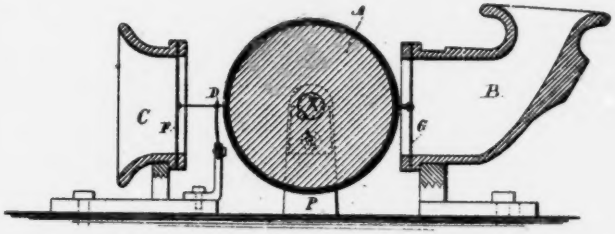


Fig. 4.

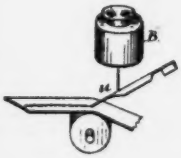
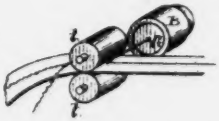


Fig. 3.



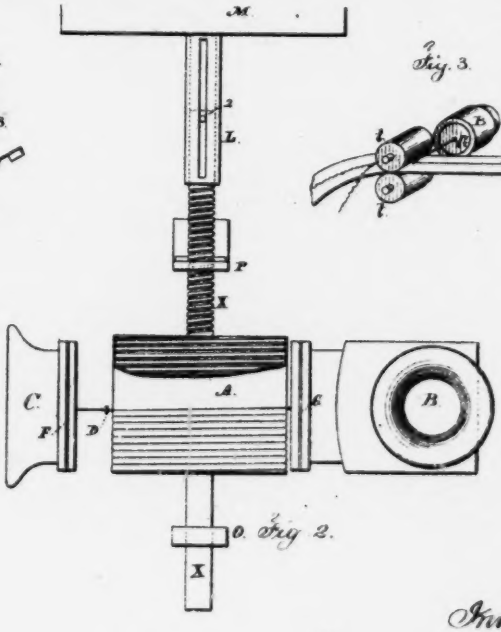


Fig. 2.

Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. 200,521, dated February 19, 1878; application filed December 24, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, X, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L, the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall

exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the transmitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm C, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm, the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets—Sheet 1.

337

T. A. EDISON.
Automatic-Telegraph.

No. 213,554. Patented Mar. 25, 1879.

Fig. 2.

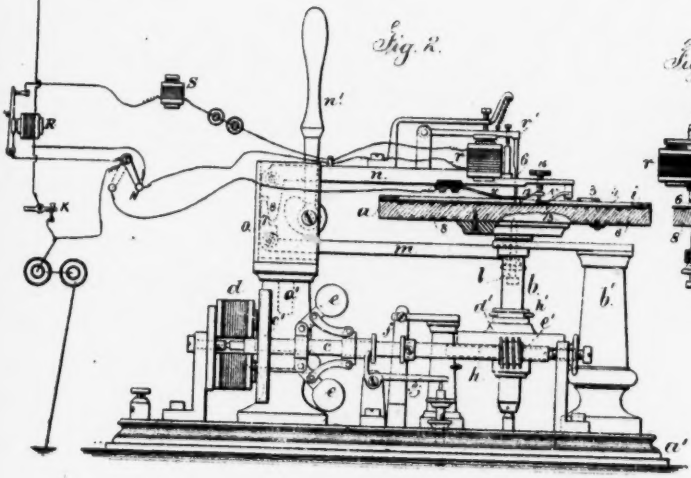
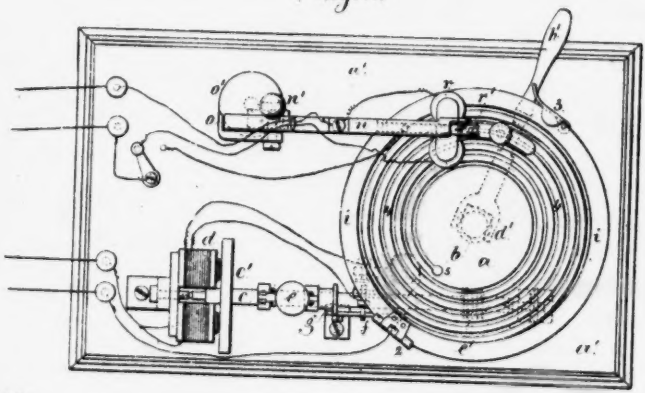


Fig. 3.

Fig. 1.



Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
by Lemuel W. Serrell
Jun.

2 Sheets—Sheet 2.

338

T. A. EDISON.

Automatic-Telegraph.

No. 213,554. Patented Mar. 25, 1879.

Fig. 5.

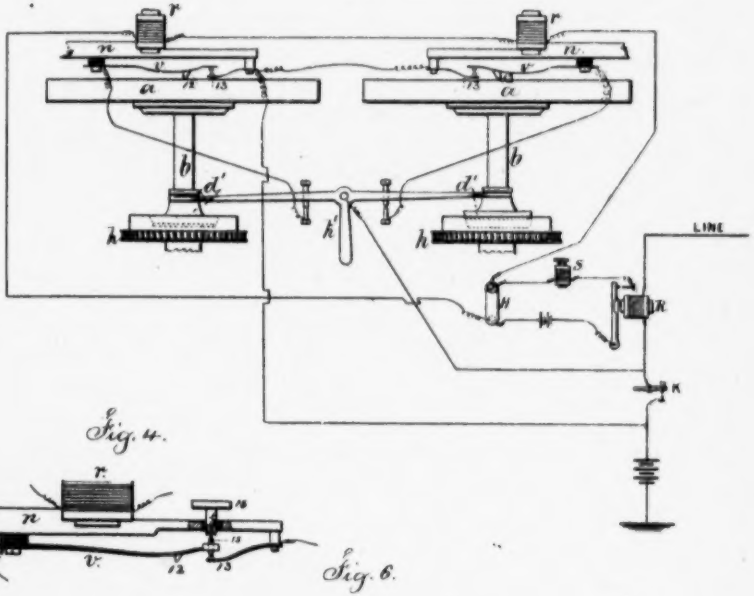


Fig. 4.

Fig. 6.

Witnesses

Chas. N. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **212,554**, dated March 25, 1879; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

The object of this invention is to indent upon a sheet of paper the characters received from a distant station, or the characters transmitted from the same station, and to use such sheet of paper to transmit the same message, thus providing an automatic device for transmitting the same message more than once from one station to different stations, and for retransmitting the message automatically where it has to pass through several offices to reach its destination.

In the drawings, Figure 1 is a plan of the instrument. Fig. 2 is a side view with the indenting-plate in section; and Fig. 3 is a section of part of the indenting-plate and pin.

In chemical telegraphs a sheet of paper has been clamped to a disk, and the stylus resting upon such paper has been moved gradually toward or from the center of the disk by a volute groove in the surface of the disk itself or in a separate plate.

I make use of a volute groove in a disk or plate; but the first part of my invention relates to the disk or plate with volute groove or channel in the under surface and the guiding-point below such plate, while the point that operates upon the paper is above that plate.

The disk or plate *a* is mounted upon the vertical shaft *b*, sustained by the standard *b'* and bed *a'*. Any suitable motor is applied to revolve the shaft *b* and plate *a*.

I have shown an electric engine consisting of the shaft *c*, armature *c'*, stationary magnets *d*, governor-balls *e*, circuit breaker or commutator *f*, and lever-arm *g*, operated upon by the governor to open or close the local circuit to the magnets *d*, according to the speed of the engine, and thereby obtain uniformity. This electric engine is similar to that shown in my Patent No. 131,343.

The worm *c'* upon the shaft *c* serves to rotate the wheel *h* upon the shaft *b*, and there is a friction-clutch, *d'*, and lever *h'*, by means of which the wheel *h* is connected with or disconnected from the shaft *b*.

Upon the plate *a* is a clamping-frame, *i*, preferably hinged at one side, 2, and provided with a swinging catch, 3, at the other side. The paper to receive the message is laid upon this plate *a*, and held by the frame *i'* around its edges.

There are to be guide-marks upon the paper and also upon the disk *a*, so that the paper can be correctly positioned upon the disk in the first instance, and replaced absolutely correct when required. For this purpose it is preferable to perforate the paper at the center and at a point corresponding to the hole 5.

The volute groove 8 is upon the bottom of the plate *a*, and in it is the point of the pin *l*, that is at the end of the arm *m*, and above the disk *a* and paper is the marking-point 6 at the end of the arm *n*.

These arms *m* and *n* are hinged to a stock, *o*, upon a vertical standard, *o'*, and there is a vertical pivot upon which the stock *o* and the lever-arms *m n* swing horizontally. The arms *m n* have right-angled toes, as seen by dotted lines at 7 and 8, and the weight of the arm *n* is greater than that of *m*, and hence the point *l* is raised up into the volute groove, and the point 6 rests upon the paper. The lever *n'* acts to raise the point 6 off the paper by pressing the lever-arm *m* downwardly when it is desired to move both points away from the paper.

The marking-point 6 is made to indent the paper by the action of the electro-magnet *r* and its armature-lever *r'*, and thereby produce Morse or other characters by pressing the paper down into the groove 4 of the disk *a*, and this electro-magnet *r* is either in the main line or (by preference) in a local circuit.

In Fig. 2 these circuit connections are illustrated. The relay-magnet R operates by its armature the local circuit to the electro-magnet *r*, and in this is placed the sounder *s*.

The operator at the receiving-station closes the switch H of his key K, and the sending operator opens his switch.

When the instrument is employed to trans-

late or repeat the message into another circuit the delicate insulated spring circuit-closer *r*, tracing-point 12, and contact-point 13 are made use of, and these are placed in the circuit into which the message is to be sent in order that the tracer 12 may lift the spring *v* and break the circuit when resting on the portion of paper that is not indented, and when the indented portion is beneath said point the spring closes the contact at 13, and the message is sent to the distant station.

The arrangement of circuits shown in Fig. 2 is convenient. In this the movement of the switch H to the dotted positions causes the main-line circuit to pass through the insulated spring circuit-closer *r*, point 13, arm *u*, so that the indented paper will give motion to the circuit-closer and transmit the message previously recorded.

The spring 13 rests upon the paper, and the circuit-closing spring *v*, carrying the point 12, has also the screw 15 to close the circuit upon the spring 13 when the indentation passes below the point 12. This screw 16 requires to be adjusted to suit the condition of the paper or of the indentations. I therefore provide a T-head to the screw, and a turner, 16, above it, which passes through the arm *u*, so that the adjustment can be made while the instrument is at work, the said turner being insulated and having a notch for the T-head of the screw, as shown in Fig. 4.

There may be two disks arranged to receive their motion from the prime mover, each having a friction-clutch that is operated by a double lever, *h'*, whereby one disk is disconnected and stopped simultaneously, or just after the other disk is put into motion, so that when one paper is full its disk may be stopped just after the other is started, so as not to drop any signals, and the paper that is full is removed and another paper substituted. The same devices are available either in receiving or in sending messages.

In the diagram, Fig. 5, the connections for this purpose are shown, and the lever *h'* closes the circuit through the spring circuit-closer *r* and contact-point 13 in the act of shifting the power from one of the disks to the other.

It will generally be preferable to make the volute grooves in square or oblong plates, so as to receive ordinary square or oblong sheets of paper. These can be more easily filed away for future reference, and contain the dates and facts desired upon the face of the paper, in the angles thereof. Fig. 6 shows one of these square blanks. The message can be read upon these blanks, or it can be repeated at any time.

In place of having only one contact spring and point, it may be preferable to have three, placed side by side and close together, so as to allow for any inaccuracy in the position of the paper, or that may result from expansion or contraction of the paper. Either one of these points passing into the indentation in the paper will close the circuit and transmit the signal. The screw 16 allows the contact-points to be adjusted to suit the paper that is in use.

A puncturing or perforating point might take the place of the indenting or embossing point.

It is obvious that many modifications may be made to produce the same result. For instance, the electric engine may be replaced by a clock-work or other motor.

The arm *u* might be made to rotate instead of the plate *a*. The underneath spiral might be dispensed with, and the spiral on top of the plate might be continued out a greater distance from the center, and the additional spiral used for giving an outward movement to the arm. The plate itself might be dispensed with, and a drum used, with grooves cut lengthwise, and the indenting-magnet moved back and forward by suitable mechanism, the paper being fed from a continuous roll.

I am aware that it is not new to record telegraph-signals by indenting or embossing paper, as that method is adopted by Morse. Neither is it new to retransmit from such characters by causing them to give motion to contact mechanism, as that is shown in the English patent granted to William Thomson and Fleming Jenkin August 25, 1860, No. 2,047. Such embossing, however, was done on narrow strips of paper.

I claim as my invention—

1. In a telegraph in which the indented or embossed message is employed for transmitting electric pulsations, the means, substantially as specified, for recording the message in a volute line upon a sheet of paper, and for following that line with the circuit-breaking device in transmitting from such record, as set forth.

2. A plate provided with a volute groove upon its surface, and means for clamping a sheet of paper thereto, in combination with an indenting or perforating point, and means for maintaining the proper position of the point over the spiral groove, substantially as set forth.

3. A telegraphic blank of paper or similar material provided with one or more perforations, in combination with the plate receiving the same, and having corresponding marks to insure accurate adjustment in the various machines, substantially as specified.

4. The combination, with a spirally-grooved or volute plate, of an arm and indenting and transmitting mechanism supported by such arm, and a second similar groove for moving such arm, substantially as set forth.

5. In combination with a rest upon the paper, a point operated by the undulations of the surface of the paper and a circuit-closer and electric circuit to a distant receiving-instrument, substantially as set forth.

6. The arms *u* and *m*, pivoted to the stock *s*,

and turning upon a vertical pivot, in combination with the plate *a*, containing a volute groove, substantially as specified.

7. In combination with two revolving plates and the indenting or transmitting mechanism connected thereto, a clutch for connecting one plate before disconnecting the other, substantially as and for the purposes set forth.

8. The combination, with an indenting-instrument, electro-magnet, and spirally-grooved plate, of a sounder in the same circuit as the indenting-magnet, substantially as set forth.

Signed by me this 3d day of February, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

342

A. W. HALL.
Phonograph.

No. 219,939. Patented Sept. 23, 1879.

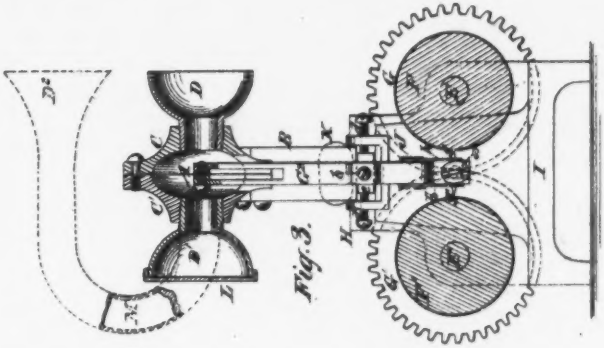


Fig. 3.

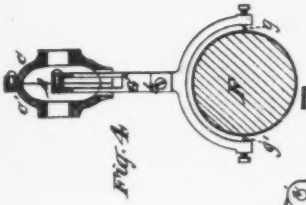


Fig. 4.

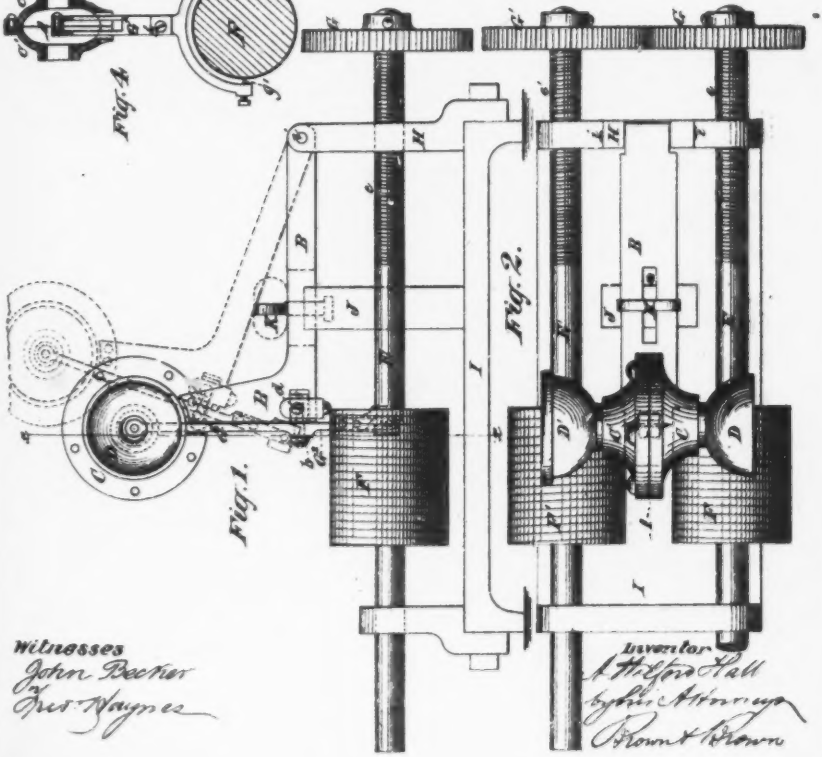


Fig. 2.

Fig. 1.

Witnesses
John Becker
Jas. Haynes

Inventor
A. Wilford Hall
by his Attorneys
Brown & Brown

UNITED STATES PATENT OFFICE.

A. WILFORD HALL, OF NEW YORK, N. Y.

IMPROVEMENT IN PHONOGRAPHS.

Specification forming part of Letters Patent No. 219,039, dated September 23, 1879; application filed November 29, 1878.

To all whom it may concern:

Be it known that I, A. WILFORD HALL, of the city, county, and State of New York, have invented certain new and useful Improvements in Phonographs; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention consists in certain improvements in the phonograph which is the subject of Letters Patent No. 200,521, dated February 19, 1878, to Thomas A. Edison. In that instrument, as described by the patentee in the specification of his said Letters Patent, the sound-recording indentations or impressions produced on the tin-foil or yielding material are obtained by a single point and from one side only of the vibrating diaphragm, which is actuated by the sounds to be reproduced, and a single record only of the sounds is made, the indentations in such record being produced by the vibrations of the diaphragm in one direction only. Moreover, the vibration of the diaphragm is more or less restricted in consequence of the method of adjustment described in said Letters Patent, such adjustment having the effect of bringing a lateral tension on the diaphragm in one direction when the instrument is in its normal condition or at rest.

The objects of my invention are to provide for a more free vibration of the diaphragm, and to more fully utilize the vibrations of the diaphragm in both directions, both in the recording and in the reproduction of sounds, whereby I believe that several important advantages may be obtained, as will be hereinafter explained.

My invention consists, principally, in the combination, with the sound-recording or sound-reproducing diaphragm, of two points and one or more moving surfaces of yielding material, suitably arranged in connection with said points, whereby a divided record of the vibrations of the diaphragm is obtained and a double action is produced on the diaphragm for the reproduction of the sound—that is to say, in obtaining the record, one half is obtained from one point and from one side of the diaphragm by the vibrations of the diaphragm in one direction, and the other half is obtained from the other point and from the other side of the diaphragm by the vibrations of the diaphragm in the opposite direction; and in the reproduction of the sound the vibrations of the diaphragm in one direction are produced from one half of the record, and those in the other direction from the other half of the record. By this means less depth of penetration of the points is required than when the record is made by a single point, and, as it is not necessary to put the diaphragm under a normal lateral tension in one direction, the diaphragm will vibrate in response to less atmospheric disturbance than when a single point and recording-surface are employed.

My invention further consists in the combination, with the diaphragm of a phonograph, of two mouth-pieces, one on each side thereof, whereby several important advantages are obtained, as will be hereinafter fully explained.

My invention also consists in several improvements of the details of construction of the instrument, as will be hereinafter fully specified.

Figure 1 in the accompanying drawing is a side view of a phonograph with my improvements. Fig. 2 is a plan of the same. Fig. 3 is a vertical section of the same in the plane indicated by the line *x x* of Fig. 1.

A is the diaphragm, which may be in any way suitably supported, but is represented as clamped between two internally-concave disks, C C′, which are supported by a standard, B, and which are represented as fitted with separate tubes and mouth-pieces D D¹, one on each side of the diaphragm. A cap, L, is provided to fit and close either mouth-piece. It is shown in Fig. 3, placed on the mouth-piece D¹.

E E′ are two shafts arranged in suitable bearings below and parallel with the diaphragm, and carrying the two cylinders F F′, upon which are to be secured the tin-foil or other yielding material upon which the record of the diaphragm is to be obtained. The said shafts have provided upon them screw-threads *e e′*, and one of the fixed bearings provided for each is provided with a corresponding female screw-thread, so that as the said shafts rotate they also have a longitudinal movement imparted to them by the act of rotation.

The said shafts are represented as geared together by gearing G G¹, to rotate at similar speeds but in opposite directions, and in order

that both shafts and cylinders may have corresponding longitudinal movements, one has a right-hand and the other a left-hand screw-thread.

The cylinders F F' have each a helical groove provided in it of a pitch corresponding with the screw-threads on its respective shaft.

Between the diaphragm A and the cylinders F F' there is attached to the standard B a lever, G', the upper part of which is forked in such manner and shape, as shown in Fig. 3, as to pass through openings provided in the disks C C', and embrace the diaphragm between the two limbs of its fork, which are so shaped as to clamp or bear upon opposite sides of the diaphragm near its center only, leaving the rest of the diaphragm free to vibrate under the influence of the sound-waves.

The lower part of the said lever is furnished with two points, *g g'*, which are so situated between or relatively to the two cylinders F F' that one is capable of touching the tin-foil or other yielding material on one cylinder, while the other is capable of touching that on the other cylinder.

The said points are attached to the lever by means of elastic carriers *h h'*, or otherwise, in such manner as to be capable of adjustment to the requisite distance apart by means of a cam or eccentric, *a*, (see Fig. 3,) or other equivalent device attached to the lever for the purpose.

The fulcrum *b* of the lever is made adjustable in the standard B by being secured in a sliding block, *c*, which can be moved upon the standard in one direction or the other by means of adjusting-screws *d*, *d'* for the purpose of setting the lever, so that when the diaphragm and lever are at rest, and the points *g g'* are at the proper distance apart, the said points may both just touch or press equally upon the yielding material on the two cylinders.

In order to provide for the removal of the lever and points from between the cylinders when it is desired to move the cylinders without producing any marks upon the yielding surfaces thereon, or when it is requisite to place, remove, or replace the tin-foil or other yielding material upon the cylinders, the standard B, upon which the diaphragm and lever are mounted, is pivoted at *e* to a stand, H, erected upon the supporting-base I of the instrument, so that the said standard, with the diaphragm and lever, can all be raised, as shown in dotted outlines in Fig. 1.

When the diaphragm and lever are in the operative position shown in Fig. 3, and in full outline in Fig. 1, the standard B rests upon a post, J, where it is then held down firmly by a button or set-screw, K.

The operation of the instrument in recording is as follows: The tin-foil or other yielding material upon which the record is to be obtained having been secured upon the cylinders, and the standard having been brought down and secured upon the post to bring the points *g g'* between the two cylinders, and the cylinders having been so adjusted lengthwise, or the points so adjusted lengthwise, of the cylinders that one of the points is opposite to a groove in one cylinder and the other opposite to a groove in the other cylinder, the points are then adjusted so that each presses very slightly upon the foil or other material on one of the cylinders, and the shafts E E' and cylinders F F' are then set in motion by the clock-work or other motor provided for the purpose.

Either mouth-piece may be used; but the other one should be covered by the cap L, to prevent the neutralizing effect of air-waves passing around and acting upon the opposite side of the diaphragm to that which faces the open mouth-piece. Words spoken into the open mouth-piece then cause the diaphragm to vibrate, and the movements will be transmitted through the lever to the pins, and the vibrations will thereby be recorded by indentations in the foil or yielding material, one half of the record being obtained upon the material on one cylinder and the other half by indentations in the material on the other cylinder, each half of the record thus produced being the exact counterpart of the other half—that is to say, the indentations produced on the material on one cylinder being opposite the ridges left between the indentations of the material on the other.

The sound may be reproduced from either side of the diaphragm; but both sides may be utilized, and in order to provide for utilising both sides the mouth-piece D or D' may be removed, and have a bent tube, M, and mouth-piece D' substituted for it, as shown in dotted outline in Fig. 3, so that the sound-waves produced on both sides of the diaphragm may be conducted in one direction.

In the operation of reproducing the sound, the vibration or movement of the diaphragm in one direction is produced by the half-record on one cylinder, and the vibration or movement in the other direction by the half-record on the other cylinder, the movements in both directions being produced in a positive manner with a velocity exactly proportioned to the velocity of the movements of the cylinders.

It is not absolutely necessary to employ two cylinders to produce the double or divided record. I have shown in the diagram Fig. 4 a construction of the lever and points whereby a single cylinder may be used, the lower end of the lever, to which the points *g g'* are attached, being forked to so straddle or embrace the said cylinder that one point may act against or be acted upon by one side of the cylinder and the other point act against or be acted upon by the other side of the cylinder. In such case the cylinder should contain two helical grooves, the turns of each intervening between those of the other, and one of the points *g g* arranged to press or touch the foil or other surface which is to receive the record opposite one of the said grooves, and the other to press or touch it opposite the other of said

grooves, so that the double or divided record may be produced on the one surface, but in distinct lines of indentations.

I have hereinbefore briefly alluded to some of the advantages resulting from this duplex system of recording and reproducing the vibrations of the diaphragm, but will now explain others of these advantages.

With a single point and a record produced from one side of the diaphragm only, the diaphragm in the reproduction of the sound can only be moved in one direction by the motion of the indented surface, swinging back in the other direction by its own normal vibration, and with a velocity only equal to its own vibrational number, which of course depends on its size, weight, and rigidity. Hence if the rotation of the cylinder should vary in speed from this normal vibrational rate, as it necessarily must do in producing tones of various degrees of pitch, it follows that a constant irregularity must occur between the rates of diaphragmatic vibrations in the two opposite directions, and this is what I believe to be the cause of the nasal intonation noticed in the single-acting instrument; but I believe that with the duplex system this defect will be remedied, as the two opposite indented surfaces driving the diaphragm positively with equal velocity in either direction in perfect alternation should reproduce the spoken words with the same intonation which formed the record.

The employment of the lever between the diaphragm and the recording-surfaces, besides obtaining the advantages hereinbefore mentioned, enables the diaphragm to be brought to a position above or out of the way of the recording part of the apparatus, and so enables both of its sides to be made available, as hereinbefore described, for reproducing the spoken words or sounds, thereby making the reproduction much louder than when the sonorous effect is produced from one side of the diaphragm only, as is unavoidable when the recording-point is arranged directly opposite to the diaphragm. Moreover, it is by placing the diaphragm in this position, out of the way of the recording apparatus, and permitting the tube or mouth-piece on one side of the diaphragm to be closed, that I prevent the neutralizing, hereinbefore mentioned, of sound-waves acting on the opposite side of the diaphragm to that against which a speaker's voice is directed.

By providing for the use of two mouth-pieces, one on each side of the diaphragm, and connecting them by tubes of suitable length with the diaphragm, two persons seated on opposite sides of the instrument may carry on a rapid and uninterrupted conversation.

Although the greatest advantages resulting from the use of a lever between the diaphragm and the recording-surface are obtained by the use of two points giving a duplex or divided record, the advantage of leverage between the diaphragm and the recording-point would be considerable with a single point giving a single or undivided record.

I do not herein claim the combination, in a phonograph, of a diaphragm, a point, and a lever intervening between the diaphragm and the point.

What I claim as my invention is—

1. The combination, with the diaphragm of a phonograph, of two points connected with said diaphragm, and one or more moving surfaces adapted to be acted upon by or to act upon said points, substantially as herein described, whereby a duplex or divided record of the sound-vibrations is obtained or employed, substantially as herein set forth.

2. The combination, with the diaphragm of a phonograph, of two recording-surfaces, or surfaces having marks thereon corresponding with sound-vibrations, a lever connected with the diaphragm and having attached to it two points adapted one to operate upon or be operated upon by one of said surfaces, and the other to operate upon or be operated upon by the other of said surfaces, for the purpose of obtaining or employing a duplex or divided record, substantially as herein described.

3. The combination, with the diaphragm of a phonograph, of two cylinders adapted to carry yielding recording-surfaces, or surfaces having marks thereon corresponding with sound-vibrations, and a lever connected with said diaphragm and carrying two points, one of which is arranged to operate upon or be operated upon by the surface on one of said cylinders, and the other of which is arranged to operate upon or be operated upon by the surface on the other of said cylinders, substantially as and for the purpose herein set forth.

4. The combination, with the diaphragm of a phonograph, of two tubes and mouth-pieces, one on each side of the diaphragm, substantially as and for the purpose herein specified.

5. The combination, with the diaphragm of a phonograph and two mouth-pieces, one on each side thereof, of a cap adapted to fit and close either of said mouth-pieces, substantially as and for the purpose herein described.

6. The combination, with the diaphragm of a phonograph, of a mouth-piece communicating directly with one side of the diaphragm, and a bent tube communicating with the other side of the diaphragm and furnished with a mouth-piece presenting its opening in the same direction as the said directly-communicating mouth-piece, substantially as and for the purpose herein specified.

A. WILFORD HALL.

Witnesses:
FRED. HAYNES,
T. J. KEANE.

2 Sheets—Sheet 1.

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T. A. EDISON.
Phonograph.

No. 227,679. **Patented May 18, 1880.**

Fig. 1.

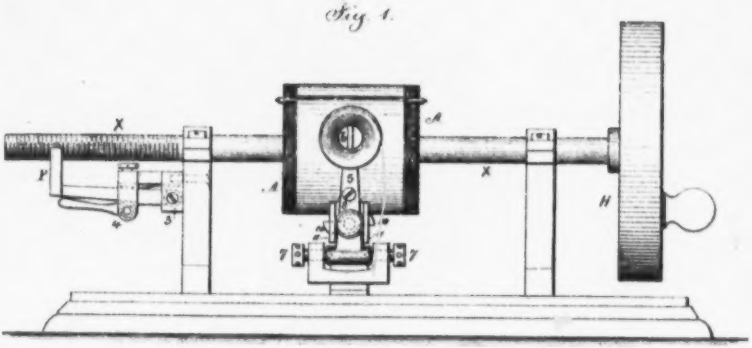

Fig. 2.

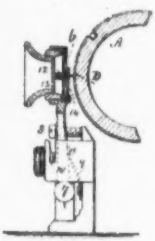

Fig. 5.

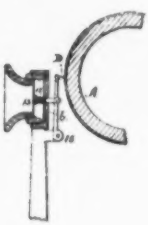

Fig. 6.

Witnesses.
Harold St. Perrell
Chas. H. Smith

Inventor
Thomas A. Edison
per Samuel A. Perrell
atty.

2 Sheets—Sheet 2.

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T. A. EDISON.
Phonograph.

No. 227,679. Patented May 18, 1880.

Fig. 6

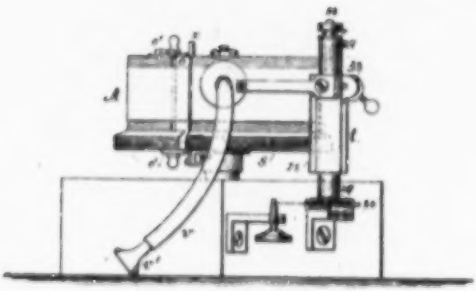


Fig. 7

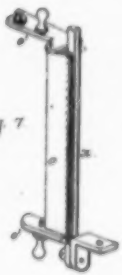
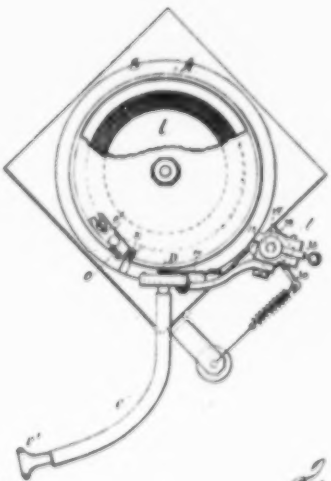


Fig. 5



Witnesses
Harold Serrell
Chas. A. Smith

Inventor
Thomas A. Edison
per Samuel W. Pruess
Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 227,679, dated May 18, 1880

Application filed March 22, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Phonographs, (Case No. 174,) of which the following is a specification.

In Letters Patent No. 200,521, granted to me, a cylinder with a helical-grooved surface is revolved with its screw-shaft and moved along endwise. Upon this cylinder there is a sheet of foil or similar material, and the same is indented by the action of a point moved by a diaphragm, and this foil forms a phonogram that can be used to reproduce the original sounds when moved in contact with a point and diaphragm. In the said patent one of the points is shown as connected directly to the diaphragm, and the other point is upon a spring.

My present invention relates to improvements upon the phonograph patented as aforesaid, and the features of such improvement are hereinafter specially pointed out.

In the drawings, Figure 1 is an elevation of the phonograph. Fig. 2 is a section of the diaphragm. Fig. 3 is an end view of the cylinder containing the foil. Fig. 4 is a side view of the diaphragm and the device for moving the same.

The cylinder A has a grooved surface, as in aforesaid patent, and it receives the tin-foil or other material that is to be indented by the action of the diaphragm *b* and point to produce the record of the sound, which I term the "phonogram," and the diaphragm E and point D are adapted to form a phonet and reproduce the sound; but it is to be understood that the same point and diaphragm may be employed to record and to reproduce the sound.

In my present invention, as in my former patent, the motion of the recording-surface may be derived from clock-work, hand, or other power.

In order to insure great uniformity of speed and prevent irregularity in the movement by inaccuracies of work, dust, lack of oil, or any other source of local friction or resistance, I make use of an abnormally heavy fly-wheel, H, upon the shaft of the phonograph, so as to prevent any trembling movement and to resist any tendency to increase or lessen the speed, for upon uniformity of speed of the phonet with the phonograph depends the accuracy of reproduction, especially in musical sounds, that depend for their tone upon the number of vibrations per second.

The nut P is upon a lever pivoted at 3 and kept in contact by a cam, 4. When this lever and nut P are lowered the shaft X and cylinder A can be slipped endwise.

The arm 5, carrying the diaphragm *b*, should be pivoted at 7 7 by pointed screws, so as to adjust the position of the recording-point of the diaphragm *b* relatively to the grooves of the cylinder. The screw 8 determines the position to which the diaphragm and recording-point may approach to the cylinder. The spring 9 serves to move the arm 5 away from the cylinder, and the double-ended locking-piece 10, entering slots in the frame 11, holds the arm in place when in use.

One of the peculiarities of the present invention over the aforesaid patent is a spring, 12, of india-rubber or other suitable material, placed between the cross-bar or bridge 13 and the diaphragm, that serves as a damper to prevent false vibrations of the diaphragm and cause it to respond only to the actual movement given by the phonogram through the point D. It is also usually preferable to employ a spring, 14, between the point and the diaphragm. This is useful, in both the phonograph and the phonet, to prevent false sounds. This spring and diaphragm I have used in connection with telephones. I do not, therefore, herein lay claim to the same, broadly. I have combined the same with the recording or phonet point and the phonogram.

Another feature of invention relates to a lever between the diaphragm and the phonogram, whereby the relative movements of the parts may be varied. This lever *e* has a fulcrum at 15. If the connection to the diaphragm is between the point D and fulcrum 15, as in Fig. 5, then the motion of the point will be greater than the diaphragm, and when used in the phonograph will amplify the indentations

in the foil. If used in the phonet, the movement of the diaphragm would be lessened. I therefore prefer, in that instrument, to change the places of the point and diaphragm connection, as shown in Fig. 6, so as to amplify the movement of the diaphragm and increase the sound.

Another feature of my present invention relates to the foil-holder, which I place on a reel within the cylinder A, and draw the same out through a slot, as required from time to time, thus preserving the foil from injury and rendering it unnecessary to handle the same.

The reel *l* within the cylinder A is adapted to receive the foil in a roll upon it. One head of the cylinder is removable, so as to allow of the insertion or withdrawal of the reel. There is a slot in the cylinder, through which the foil is brought out, and there is a bar, *o*, forming part of the periphery of the cylinder, that is connected at its ends to the slides *o'*, (see Fig. 7,) one at each end of the cylinder, and there is a lever-bar, *x*, behind this slide-bar *o*. When the slide *o'* is drawn back from over the lever *x*, such lever can be swung out of the slot in the cylinder A, and the foil can be drawn out of the slot and wrapped around the cylinder, and then the end is placed behind the bar *x*, and carried by it into the slot of the cylinder, and then the slide *o'* is moved so that its edge passes over the lever *x*, and in so doing the foil is tightened around the cylinder and the lever *x* held in place. The surface of this cylinder is made with a helical groove, and the rim *s* of the cylinder is made with a similar screw or groove, and the sliding sleeve *t*, that carries the diaphragm-arm, has a screw-surface at 25, that comes into contact with the screw *s*.

With this character of instrument it is preferable to have the cylinder A upon a vertical shaft, and the sleeve *t* and diaphragm will be moved vertically. For this purpose the fixed stud 28 is vertical, and upon it is a tube, 29, of a size to receive the sleeve *t*, and having a groove and key, by which the sleeve *t* is allowed to slide endwise of the tube 29; but the two can be turned together on the stud or shaft 28. An arm, 30, on the tube 29, and a spring, serve to turn the tube, the sleeve, and the diaphragm and arm with sufficient force to bring the point D to bear upon the foil with the required force.

It is preferable to employ with the diaphragm a tube, *r*, and mouth-piece *r'*, such tube being flexible.

The speaking into and recording of the sounds in the phonograph will be proceeded with as usual, and the reproduction of the sounds will be as before; but in case the operator wants to suspend the recording in the phonograph or the speaking in the phonet he simply has to draw upon the flexible tube, which swings the parts so as to disconnect the screw-rack from the flange *s* of the cylinder. This at the same time moves away the recording or the phonet-point. The cylinder A can continue to revolve, and when the operator is ready he releases the pull upon the flexible tube, and the parts commence to act again at the exact place where the operation was suspended, because the screw-threads will only drop together when the proper part of the thread *s* comes to the corresponding part on the rack 25.

I employ the cam 33 and its lever upon the sleeve *t* to act upon the tube 29 and prevent the sleeve falling when the screw-threads are disconnected. This cam-lever 33 is self-acting, and it has to be raised when the sleeve *t* is to be lowered, so as to recommence at one end of the cylinder A.

By simply turning the sleeve and moving the diaphragm and the screw-surface back, the sleeve and diaphragm can be slipped endwise to any desired place upon the cylinder A to receive or deliver sounds.

I am aware that fly-wheels are employed in numerous ways for equalizing the speed of machinery. I do not claim the same, broadly. In experimenting with my phonograph I discovered that the reproduction of the sound was imperfect if the slightest variation occurred in the speed; hence the combination with the cylinder of a very heavy fly-wheel in proportion to the cylinder rendered perfect and reliable the action of the instrument in receiving and reproducing the sound by equalizing the speed.

I claim as my invention—

1. The combination, with the phonograph cylinder, shaft, and screw-surface, of a swinging nut or screw-surface, to connect or disconnect the parts that keep the recording or phonet point in position relative to the groove of the cylinder, substantially as set forth.

2. In combination with foil or a sound-recording surface, a point, a diaphragm, and a spring or damper acting to press the diaphragm toward the point, substantially as set forth.

3. In combination with a foil or sound-recording surface, a point, a diaphragm, and a spring between the point and the diaphragm, substantially as set forth.

4. The combination, in a phonograph or phonet, of a diaphragm, a point and a lever intervening between the diaphragm and the point, substantially as set forth.

5. The combination, with the spirally-grooved cylinder in a phonograph, of a reel within the cylinder carrying the foil or similar recording material, a slot in the cylinder, through which the foil is led out, and means for clamping the foil, substantially as set forth.

6. The combination, with the cylinder A, of the sliding bar *o* and lever *x*, to clamp the foil and stretch the same, substantially as set forth.

7. The swinging sleeve *t*, having an arm that carries the diaphragm, in combination with the cylinder A, and rim *s*, having a screw-thread surface, substantially as set forth.

8. The tube 29 upon the fixed stud 28, in combination with the sliding sleeve *t*, the diaphragm, and the cylinder A, substantially as described and shown.

Signed by me this 19th day of March, 1879.

THOMAS A. EDISON.

Witnesses:

S. L. GRIFFIN,

WM. CARMAN.

351

(No Model.) 3 Sheets—Sheet 1

W. A. LEGGO.

Automatic Telegraph.

No. 238,929. Patented March 15, 1881.

Fig. 1.

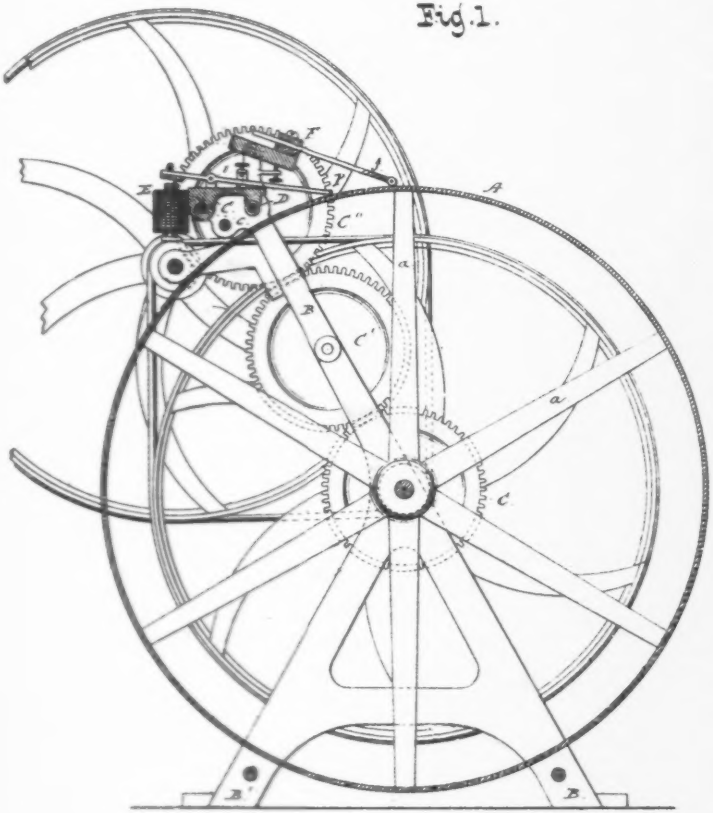


Fig. 4.

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by Dyer & Wilber
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352
(No Model.)

3 Sheets—Sheet 2

W. A. LEGGO.

Automatic Telegraph.

No. 238,929. Patented March 15, 1881.

Fig. 2.

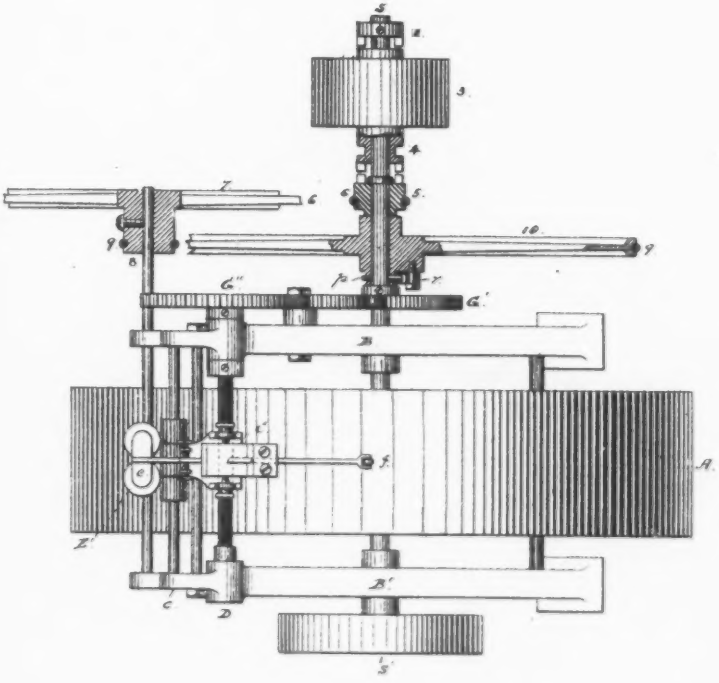

Fig. 3.

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353
(No Model.)

3 Sheets—Sheet 3

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Automatic Telegraph.

No. 238,929. Patented March 15, 1881.

Fig. 5.

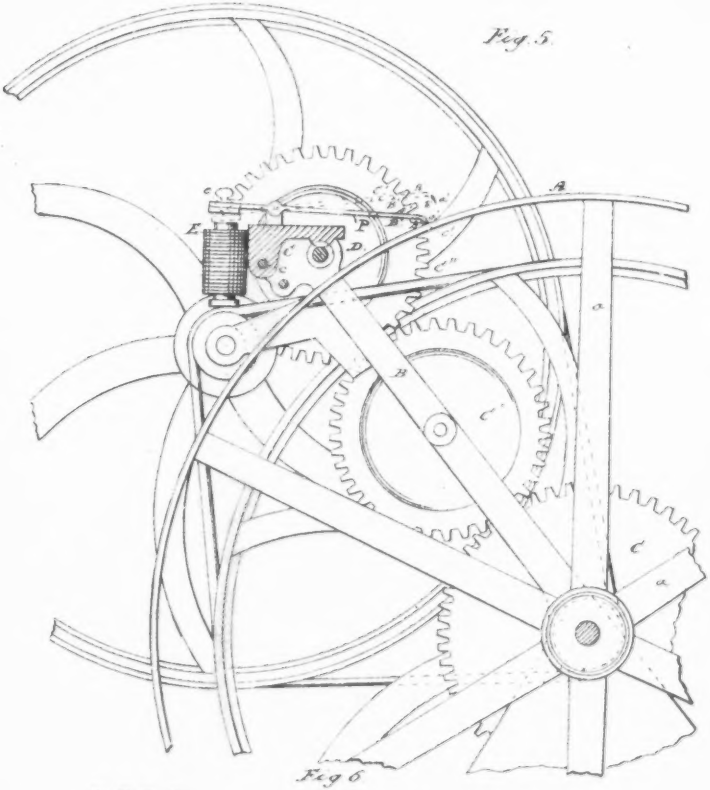
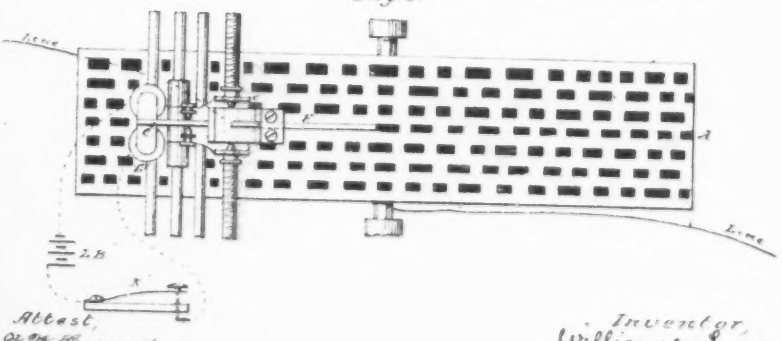


Fig 6



Witnesses,
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M. J. Hagell

Inventor,
Williams A. Leggo
per Dyer & Miller
Attys

UNITED STATES PATENT OFFICE.

WILLIAM A. LEGGO, OF NEW YORK, N. Y., ASSIGNOR TO ELECTRO GRAPHIC MANUFACTURING COMPANY, OF SAME PLACE.

AUTOMATIC TELEGRAPH

SPECIFICATION forming part of Letters Patent No. 238,929, dated March 15, 1881.

Application filed November 30, 1880. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. LEGGO, of New York, in the county of New York and State of New York, have invented a new and useful Method of and Means for Automatic Electro-Telegraphy; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object of this invention is to furnish a system of automatic rapid telegraphic transmission in which the preparation of the message may be accomplished by the use of the ordinary key, thus avoiding the use of perforated paper and the necessity of machinery for perforating the paper, enabling one machine to be used both for the preparation for transmission and for the transmission of messages. A metallic drum capable of rotation in suitable bearings is arranged to be driven by any desirable motive power. Two sets of gearing are arranged between the prime motor and the drum, the change from one to the other being quickly and easily made by a shifting-lever. One set is calculated to give a comparatively slow rate of rotation to the drum for the reception upon it of the message at the ordinary speed of the "Morse operator," the other set giving the rapid rate permissible in automatic transmission. Upon a carriage are mounted, in such relation to the drum that when desired they may take thereupon, a stylus for transmission of the message placed upon the drum and a pen for placing the message thereon. This pen is controlled by a magnet mounted upon the carriage, the pen normally resting at its outer end upon the drum, while upon the other end of its lever it is provided with an armature, so that when the magnet is charged it is lifted from the surface of the drum, or vice versa. To the magnet leads a circuit from any suitable source of electric energy, a proper key being interposed in such circuit. The pen is charged with an insulating-ink, which may be any ordinary ink, to which has been added a little gum, mucilage, or sugar.

In operation the drum is set to rotate at its slower rate and the Morse key operated in the usual manner, the stylus being thrown back from contact with the drum. While the key is open the pen rests upon the drum, placing thereon a line of insulating-ink, whose width depends upon the width of the pen, which may be of any desired or effective width. Upon closure of the key the pen is lifted from contact with the drum, leaving its metallic surface clear. Thus the message is placed thereon in a series of insulating and conducting spaces, the latter representing the signals or the unitary portions forming a signal. When this preparation of the drum is completed the stylus is thrown down into contact with the drum and the pen removed therefrom. The stylus and drum are properly connected in the circuit leading to the point of reception, and the gearing shifted to give the drum its higher rate of rotation, whereupon impulses are transmitted over the line with great rapidity, corresponding exactly to the impulses which, through the medium of the pen, caused the record upon the drum.

It should be noted that the carriage carrying the stylus and the pen and its magnet is mounted upon a shaft on which it may slide, and rests also upon a screw-shaft receiving motion through intermediate gearing from the shaft of the drum, so that while the drum is rotating the carriage has a properly-adjusted motion at a right angle to the line of rotation, causing the pen and stylus to describe a spiral line upon the surface of the drum. The carriage rests upon the screw-shaft by a half-nut only, or by a pin, or by a knife-edge, so that it may be lifted therefrom and slid back to the starting-point upon the completion of its range of motion.

The message is received upon any suitably-prepared chemical paper, as is well understood in automatic chemical telegraphy, although the paper prepared with nitrate of silver and then lubricated, as set forth in other applications of even date herewith, is preferable.

It is desirable that the drum or other metallic surface used in the transmitter should be first thoroughly cleaned, and that then a coating of gum or equivalent be applied to its surface, the surface then being washed until all the superfluous gum be removed—in fact, till to ordinary tests, feeling or visual, no gum

apparently remains. Such treatment does not interfere with its conductivity, but serves to fill up any pores in the surface of the metal, rendering it smooth and avoiding or diminishing to a minimum friction thereon, and further preventing the adhesion thereon of any greasy matter, so promoting the preparation thereon of the message in insulating-ink.

By the arrangement thus generally sketched the Morse operator, using his key in the ordinary manner, may prepare and compose the matter to be set for automatic transmission, two or three minutes then sufficing for the transmission of what has occupied an hour for preparation, and which would have occupied an hour in transmission over the wire by the ordinary Morse method of telegraphy. This system, then, makes one wire suffice practically for many operators, increasing to that extent the capacity of each wire and providing for large amounts of business without the expenditure of large sums of money in additional wires, &c.

The same general principles are exceedingly applicable and desirable for fac-simile telegraphy. For such transmission the message, which may be a writing, map, plan, chart, picture, or anything else capable of graphic representation, is written or imprinted upon the face of the drum, which is then caused to rotate, as before explained, a perfect fac simile thereof being produced at the receiving station.

It is evident that, instead of the surface of the drum being used, a plate, band, ribbon, tape, or any other equivalent form may be used, which may be prepared in any desirable manner, and then placed in the machine, which in that case need have only the suitable quick motion; further, that instead of a drum a flat plate may be used, or any other form of message-receptacle, to which is connected gearing for giving the two rates of motion—slow and fast—hereinbefore described, when such plate is used in the machine for both preparation and transmission.

In the drawings is illustrated a convenient form of mechanism for carrying into effect the invention, Figure 1 being a side view and Fig. 2 a top view thereof, while Fig. 3 shows a detail for locking the gearing to the shaft. Fig. 4 is a diagrammatic representation of a signal as it appears upon the drum prepared for transmission. Fig. 5 is a detailed cross-section of the pen and a portion of the connected apparatus, and Fig. 6 a plan of part of the apparatus, showing the surface of the drum and circuit connection.

B B′ is a framing in which is supported the shaft S, upon which is mounted the drum A. Upon the shaft is the loose pulley 3, moved thereon by means of a shifting-lever (not shown) taking into the recess 4, in the sleeve of the pulley. On the shaft S is fixed the clutch 2, with which the pulley may be locked, so that the shaft and drum may be rotated directly with the pulley, a high rate of speed being the result. Loose upon the shaft S is the small pulley 5, from which a belt, 6, leads to pulley 7, from whose small or pinion pulley 8 a belt, 9, leads to pulley 10, also loose upon S, but provided with pawl *r*, taking upon rotation in the proper direction against pin *p* in shaft S and causing S to rotate with it. If the loose pulley 3 be thrown to engage with 5, its motion is communicated to S and A through 5 7 8 10, its motion thereby being very much slowed down.

Within the upward extensions of the parts B B of the framing B B′, and upon a shaft, *c*, supported in B B, is mounted a carriage, C, capable of moving horizontally along *c* and of turning thereon vertically as upon a pivot. At the front end of C a half-nut is formed, which rests upon the screw-shaft D, which receives the motion from S through gears G G′ G″. Upon this carriage is mounted a pen, P, pivoted thereon, and having upon the end of its lever an armature, *e*, taking over the poles of a magnet, E, supported and carried by the carriage C, and which is in an electrical circuit provided with any suitable key.

In Fig. 5 the operation of the pen is more clearly shown. As shown in dotted lines, the pen is raised from the drum, and the parts A′ B′ spring together at *a′ b′*, preventing the egress of the fluid C′, which is an ink treated so as to possess insulating qualities. When, however, the pen is allowed to rest upon the drum, as shown in full lines, the parts A′ B′ are separated and the ink escapes at *c′*, the result being as shown in Fig. 6, in which the black spaces represent the intervals during which the circuit would be broken, while the clear spaces indicate the closures necessary to the transmission of a message.

In Fig. 6 the dotted lines represent a local circuit, in which is included the key K′, local battery L B, and magnet E. The key being closed, the magnet attracts *e*, lifting the pen from the drum. The line is connected on one side to the pen *c* and stylus F and on the other to the drum, the stylus and pen being insulated from the drum.

The pen P is of such a construction that when lifted from the drum it shall not permit the ink to escape therefrom, but that the mere laying of the end upon the drum or other surface shall cause it to open and permit the escape of the ink. Such a pen is shown in another application of even date herewith.

Upon the carriage C is also pivotally supported the stylus F, whose end preferably carries a roller, *f*. This stylus, when in use, lies upon the surface of the drum. When not in use it is raised therefrom.

The operation is as follows: The pulley 3 is thrown to engage with clutch 5, and thus rotate the drum at low speed. The stylus F is turned up from contact with the drum, the pen P, charged with ink, bearing normally upon the surface of the drum, laying thereon an insulated line. The operator manipulating his key, the magnet E attracts the armature *e* whenever

the circuit is closed, lifting the pen from the drum and leaving thereon the conducting signal-spaces, as shown at *n n n*, Fig. 4. The drum, rotating, causes the rotation of D, giving a horizontal movement to C, so that the entire surface of the drum may be covered by a spiral line. When as much as is desired has been composed upon the drum the carriage is lifted from contact with D and slid back to the place of starting, the pen is removed from contact, and the stylus is put into contact with the drum. The pulley 3 is thrown to engage with 2, and thus to rotate the drum at high speed. The stylus and drum are properly connected in the electrical circuit and the motive power applied. As the stylus passes over the places inked by the pen the circuit will be broken and no current will pass, while in passing over the spaces left clear by the raising of the pen the circuit will be closed and impulses sent, these impulses corresponding exactly to the impulses used in preparing the drum, which were the same as though the key had been connected directly in the transmitting-circuit.

In describing the operation it was stated that the pen is moved back to the place of beginning for transmission. Instead thereof the motion of the machine may be reversed and the last of the message placed in the drum transmitted first. When all the message has been received it is simply necessary to commence the reading at the last end of the receiving-strips, which in practice will be probably the more convenient.

As hereinbefore described, a positive copy of the message to be sent is shown as placed upon the drum. When desired a negative copy may be placed thereon, in which case the unitary members of the signals would be placed upon the drum in insulating-ink, while the spaces, &c., would be left clear—the reverse of what is shown in Fig. 4.

It is evident that the magnet E and its circuit and the key therein may be dispensed with when desired, and that the end of the pen itself may be used as the key, the operator manipulating the pen itself directly, instead of controlling it indirectly through intermediate devices.

What I claim is—

1. The method of automatic transmission herein described, which consists in causing the ordinary manipulations of a key to be recorded in insulating and conducting spaces upon a suitable surface, and then using the record so made to automatically control the transmitting-circuit, substantially as set forth.

2. The combination, with one transmitting-surface, of two sets of gearing, one adapted to give the surface a much greater speed of movement than the other, and means for changing from one to the other, substantially as set forth.

3. The combination, in an apparatus for preparing messages for telegraphic transmission, of a conducting surface, a pen adapted to normally ink the surface thereof, and devices arranged to lift the pen from the surface when it is desired to indicate thereon signals for transmission, substantially as set forth.

This specification signed and witnessed this 19th day of November, 1880.

W. A. LEGGO.

Witnesses:

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JAMES A. PAYNE.

357
(No Model.)

3 Sheets—Sheet 1.

J. H. ROGERS.

AUTOMATIC TELEGRAPH.

No. 277,349. Patented May 8, 1883.

Fig. 1

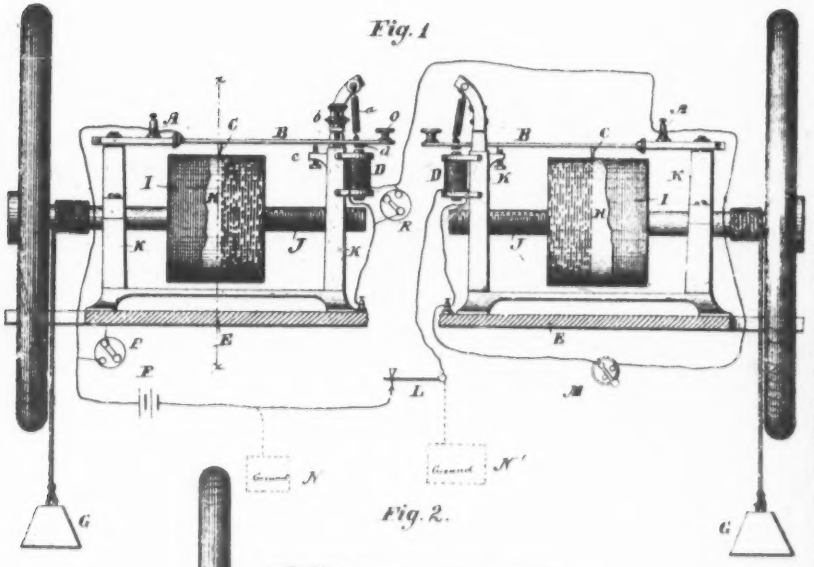


Fig. 2.

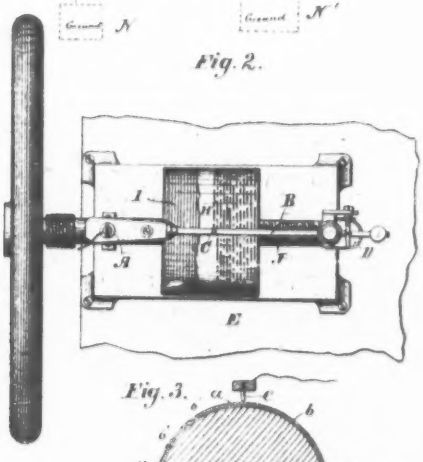
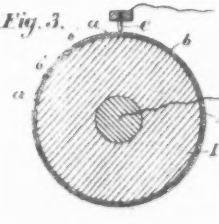


Fig. 3.



Witnesses

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357

358
(No Model.)

3 Sheets—Sheet 2.

J. H. ROGERS.

AUTOMATIC TELEGRAPH.

No. 277,349. Patented May 8, 1883.

Fig. 4.

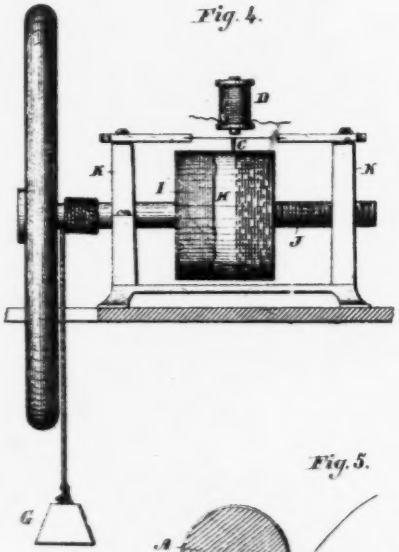


Fig. 5.

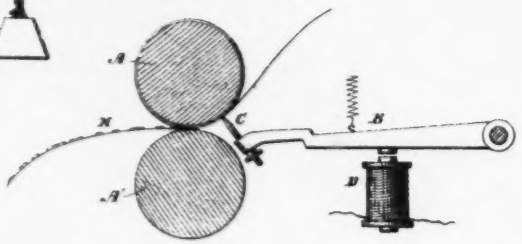
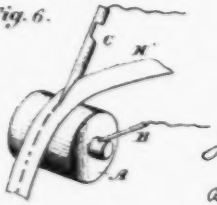


Fig. 6.



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359
(No Model.)

3 Sheets—Sheet 3.

J. H. ROGERS.

AUTOMATIC TELEGRAPH.

No. 277,349. Patented May 8, 1883.

Fig. 7.

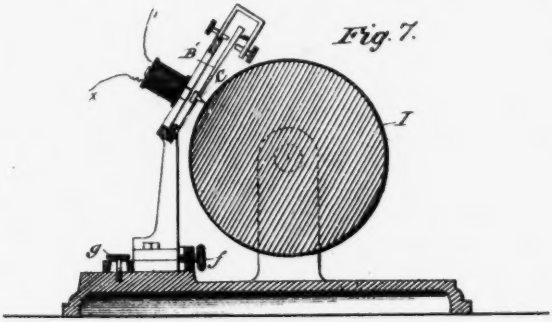
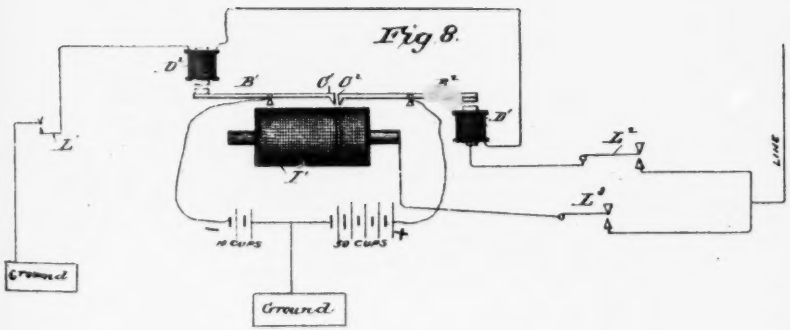


Fig 8.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 277,349, dated May 8, 1883.

Application filed March 7, 1883. (No model.)

To all whom it may concern:

Be it known that I, JAMES HARRIS ROGERS, of Washington city, District of Columbia, have invented a new and useful Improvement in Automatic Telegraphs; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

In the system of telegraphy known as the "automatic" or "rapid" system various means have been resorted to for sending and receiving electric impulses of greater or less duration to form dots and dashes to conform to the Morse code.

Among those systems which are most analogous to the improvement which I am about to describe as my invention, I may refer to a fillet of paper having a metallic face, or a thin strip of metal upon which is previously placed, in an insulating-ink, dots and dashes, which fillet, when passed through the terminal contacts of an electric circuit, make and break the same in accordance with the record, and transmit corresponding impulses to the other end of the line.

Another means of sending messages is to take a fillet of paper or other material and simply emboss, by means of a stylus, the dots and dashes, and then pass this embossed strip into a device in which the embossments act mechanically to raise and lower one end of a spring or lever, whose other end is arranged to make or break contact between the terminals of a circuit. Still another plan is that patented by me August 20, 1882, with J. W. Rogers as co-inventor, in which a thin metal strip was embossed with dots and dashes and the strip passed beneath a contact-point, which closed the circuit whenever said point touched an embossment or elevation, and broke the circuit at the intervening points. In this case it will be perceived that the metal embossment successively form the terminals of one end of the circuit.

My present invention is based upon this latter principle; and it consists in a novel arrangement of stylus and indented metal foil or sheet in an automatic telegraph for the purpose of transmitting electrical impulses by breaking connection over the indentations in the strip or sheet and making contact with the intervening spaces lying in the normal plane of the strip or sheet, in contradistinction to making contact with raised embossments.

My invention also consists in the method of preparing and transmitting a message without removal of the strip or sheet from its carrier; and also, further, in the means for avoiding tailings or static charges on the line, as will be fully set forth hereinafter.

Figure 1 is a side view, partly in section, of two of my instruments arranged for illustrating the working of the same. Fig. 2 is a plan view of one of the instruments. Fig. 3 is a cross-section through the line x x of Fig. 1. Fig. 4 is a side elevation, showing a modification of my invention. Fig. 5 shows the arrangement of a Morse register for receiving the messages transmitted by my instrument. Fig. 6 shows a chemically-prepared fillet, upon which the message may be received. Fig. 7 shows a vertical section of a further modification of the invention, and Fig. 8 shows a diagram illustrating the circuits and arrangement of parts for preventing tailings or static charges on the line.

Referring to Fig. 1 of the drawings, E is the base-plate of the instrument, provided with uprights or standards K K. In these standards are supported the ends of the shaft J of the cylinder I. The periphery of this cylinder is threaded or formed with a spiral groove, and so, also, is one end of the shaft, which latter is received into the interiorly-threaded bearing of one of the standards K. The pitch or rectilinear progression of the threads on the cylinder and its shaft is exactly the same. For giving rotary movement to the shaft and cylinder, so as to secure its progressive revolution, a weight, G, is suspended by a cord wound around its shaft, and a hand-wheel is fixed upon the shaft for winding it up or controlling its motion. These actuating devices, however, may be replaced with any other motor, or any suitable means for rotating the cylinder may be provided.

Upon one of the standards K is fixed a horizontal lever or spring-bar, B, bearing a stylus or point, C, which is adapted to press upon and indent the tin-foil into the spiral groove of the cylinder when the lever B is depressed,

and which rises out of contact when the lever B is drawn up. This lever is insulated from both of the posts K K, and is drawn up by a spring, *a*, its upward movement being limited by a stop-screw, *b*, while said lever is drawn down by the influence of the electro-magnet L upon the armature *d* borne by said lever.

Now, in describing the working of the instrument, I will first describe the simplest method of forming a record of signals for subsequent transmission. For this purpose a slow, uniform rotary motion is given to the cylinder I, and the lever B is worked by the knob O as a telegraphic key, which causes the point or stylus C to indent the tin-foil H with dots and dashes from the direct action of the key by the operator, as indicated in Fig. 3. Now, for transmitting this message the lever B is raised and the cylinder I is run back to the starting-point, so that the point C is at the beginning of the message. Electrical connections of the wires are then so arranged that the point C is one terminal of the line and the tin-foil or cylinder I the other terminal. The lever B is then slightly adjusted up by set-screw *c*, so that the stylus-point C will not touch the bottom of the grooves or indentations on the tin-foil, which are shown at *a'*, Fig. 3, but will touch the intervening spaces, *b'*. It will therefore be seen that as the cylinder revolves electrical contact is made just the reverse of the characters on the tin-foil, or by the spaces between the indentations. These electrical impulses, however, when taken off on a Morse register geared reversely to the usual manner, as in Fig. 5, will exactly reproduce the characters on the original tin-foil jacket. The distinctive feature of this part of my invention, then, it will be seen, is in making contact between the indentations, in contradistinction to closing contact with raised embossments, as in my former patent, hereinbefore referred to, and the merit of my present method is to be found in the fact that the same point which makes the indentations or manufactures the record also transmits the record by making and breaking contact, as described, without removal or transfer of the tin-foil from the place where the record is first made upon it.

I will now describe how the two instruments shown in Fig. 1 can be used—one for making and transmitting the message, and the other for receiving it. For this purpose the key L must be ignored and the ground-connections N N' considered. We will suppose the instrument on the left is the transmitting-station and the one on the right is the receiving-station. Now, switch P is open and R and M closed, and the two cylinders I I being in motion the current from battery F flows as follows: to insulated lever B and point C, touching the spaces *b'*, between the depressions on the tin-foil, and closing circuit through frame K, switch R, to line, thence to magnet D of the distant instrument, thence to ground, and thence to battery F again, so that whenever a space *b'* touches the point C in the transmitter the distant magnet attracts lever B and causes its point C to make a corresponding character on the tin-foil of that cylinder. These characters will be, however, the reverse of those on the transmitter-cylinder, and to make them identical the magnet of the receiving-instrument should be arranged to lift the point C, (instead of pulling it down on the tin-foil,) as shown in Fig. 4, for instance, in which a metal diaphragm forms the armature and carries the point C; or, instead of changing the position of the magnet, the modified form of Morse register, Fig. 5, may be used. In this connection I find it appropriate to describe what I conceive to be one of the most valuable and distinctive features of my invention, and that is its convenience and efficacy for repeating messages.

In the description of the operation of the devices in Fig. 1, where the instrument on the left has been considered the transmitter and the one on the right the receiver, it will be perceived that the message received on such instrument is in such shape that it in turn can become the transmitter to a third station without removal of the tin-foil or any other adjustment than the making of the necessary connections and the retraversing of the record by the stylus adjusted to a higher position, and so the message may be repeated indefinitely through any number of stations without an expert. This practical advantage cannot be made available where the message of automatic transmission is received on a chemically-prepared paper, because the latter cannot become a transmitting-slip, nor can it be made available with an embossed tape from a Morse register without special additional appliances.

One other use of my invention is for multiplying messages for different lines from the manipulation of a single key. To explain how this may be accomplished, the two instruments shown in Fig. 1 may be made to separately make their messages and transmit them to different points. For this purpose the key L is to be considered, and the ground-connections N N' are out. Switches P and M are closed and R is opened. By the manipulation of the key L, then, the current from the battery flows only through the two magnets D D, and the two armatures B and points C are simultaneously actuated to form the message on the tin-foil of the two instruments, and after this is done these two instruments may be separately connected to their independent lines and their separate currents then made and broken through the indented tin-foil jackets and points C, as hereinbefore described. As a matter of course any number of instruments may thus be acted upon by the same key L, and any number of multiplications of a message made to different points.

Figs. 1 and 4 show two forms of my invention, and in Fig. 7 appears still another modification. In this case a standard carrying the

electro-magnet and stylus is made adjustable to or from the cylinder by set-screws *f g*, *f* serving to limit the approach of the stylus to the cylinder, while *g* affords means for quickly moving the standard with electro-magnet and stylus back when the cylinder is to be run back to start the transmission of the message. The stylus or point C is in this case fixed to a very light hinged lever, B′, bearing an armature and working between the magnet and the cylinder, permitting the use of an ordinary Morse register for receiving in a manner as has been described with reference to Fig. 4.

I will now describe the means for clearing the line of static charge or preventing "tailings," which is a serious drawback in rapid transmission. For this purpose I employ a well-known method—namely, a current of reversed polarity, which is alternately thrown on the line. I arrange it, however, in connection with the other parts of my invention, in a manner which secures some important and useful features.

In constructing the cylinder I do not make a single continuous spiral groove in the periphery of the same, but use two parallel grooves, side by side, and employ two styluses, one of which styluses, working in one groove, sends the main impulses over the line, and the other of which alternately throws a current of reversed polarity over the line to clear the static charge.

Referring to Fig. 8, I′ is the cylinder with its jacket of tin-foil, and C′ C² are the two styluses on the ends of levers B′ B², and resting side by side in the two separate parallel grooves of the cylinder, which two grooves it will be understood traverse the periphery of the cylinder spirally side by side. One of the styluses, C², is arranged to be lifted by magnet D′, and the other is arranged to be depressed by the magnet D² by the same current passing through each, the said magnets being arranged on opposite sides of the levers carrying said styluses. To one of the styluses, C², is connected the positive pole of a battery of, say, fifty cups, and the other is connected to the negative pole of a battery of, say, ten cups, and the other poles of said batteries connect with the ground. Now, in preparing a message on the tin-foil of the cylinder I′, the key L′, it will be seen, causes the two styluses to produce exactly reversed characters on the tin-foil of the cylinder, and when this message is to be sent the key L² is opened. Then as the cylinder I′ revolves, the stylus on the right throws impulses to the line through key L² from the main battery of fifty cups, and the instant a break is made by that stylus contact is made with the other, and a current of reversed polarity from the battery of ten cups is thrown upon the line and secures the clearing of the same of tailings or the static charge.

Having thus described my invention, what I claim as new is—

1. In an automatic telegraph, the combination, with an indentable metal foil having characters indented therein, of a stylus disposed upon the side of the foil upon which said indentations were made, and arranged, as described, to break contact over the indentations and make contact on the intervening spaces lying in the normal plane of the foil, substantially as described.

2. As an improvement in the art of automatic telegraphy, the method of recording and transmitting messages, which consists in producing intermittent linear indentations representing characters in a metal foil or strip of conducting material, and then causing said indentations to successively interrupt, and the intermissions or intervening spaces in the foil to successively close an electric circuit, substantially as described.

3. A cylinder having a rotary movement with two grooves on its periphery traversing the same in parallel position, in combination with a tin-foil covering two styluses arranged to act in said grooves alternately, and two batteries connected with the two styluses for reversed currents for the purpose of following each character-impulse with an electric impulse of reversed polarity to clear the line of tailings or static charges, as set forth.

J. HARRIS ROGERS.

Witnesses:
SOLON C. KEMON,
AMOS W. HART.

363
(No Model.)

2 Sheets—Sheet 1.

J. W. ROGERS.

AUTOMATIC TELEGRAPH.

No. 283,665. Patented Aug. 21, 1883.

Fig. 1.

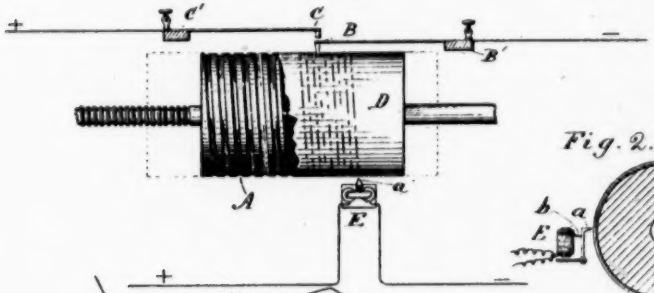


Fig. 2.

Fig. 3.

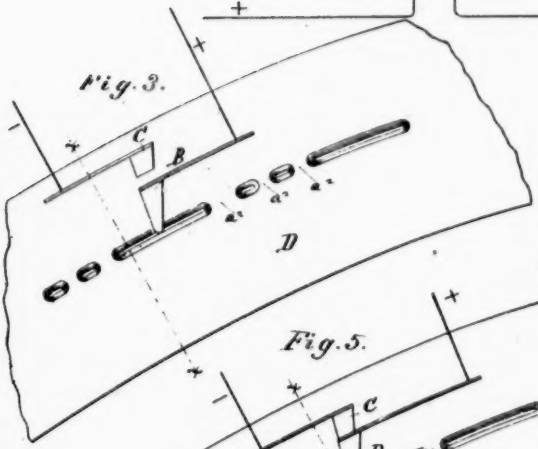


Fig. 4.

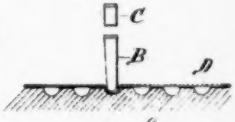


Fig. 5.

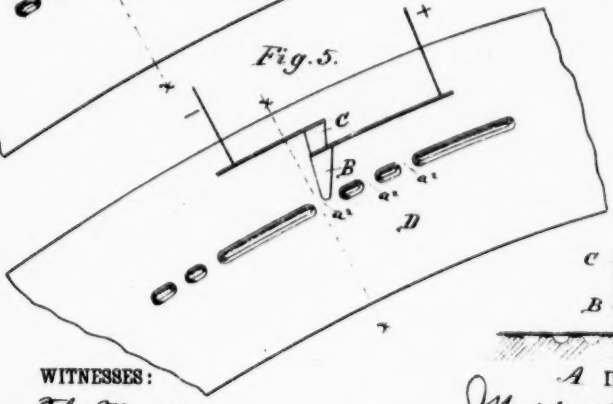
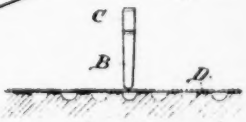


Fig. 6.



WITNESSES:

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Edwd. U. Byrn

A INVENTOR:

J. Webb Rogers

BY Munn & Co

ATTORNEYS.

364

(No Model.)

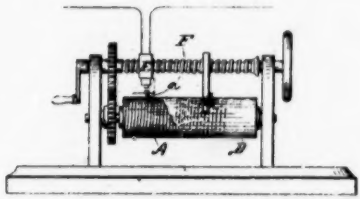
2 Sheets—Sheet 2.

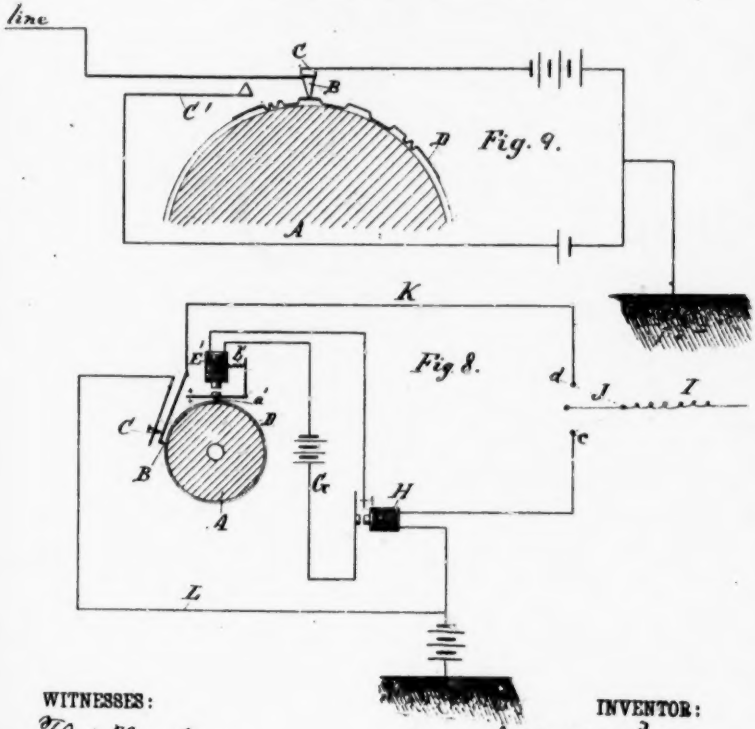
J. W. ROGERS.

AUTOMATIC TELEGRAPH.

No. 283,665. Patented Aug. 21, 1883.

Fig. 7.





WITNESSES:

Thos. Houghton.

Edw. C. Byrn

INVENTOR:

J. Webb Rogers

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JAMES WEBB ROGERS, OF NEW YORK, N. Y.

AUTOMATIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 283,665, dated August 21, 1883.

Application filed May 3, 1883. (No model.)

To all whom it may concern:

Be it known that I, JAMES WEBB ROGERS, of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Automatic Telegraphs; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side view of the cylinder with a portion of the indented jacket broken away, and showing the position of the indenting-relay and the traversing stylus. Fig. 2 is a cross-section of the cylinder, showing the relation of the indenting-relay thereto. Figs. 3 and 5 are exaggerated views in perspective, showing how the circuit is made and broken by the indentations and alternating spaces. Figs. 4 and 6 are cross-sections, Fig. 4 being taken through line *x x* of Fig. 3, and Fig. 6 being through line *x x* of Fig. 5. Fig. 7 is a side view of a modification of my invention. Fig. 8 shows a diagram of circuits for the same, and Fig. 9 shows means for avoiding tailings or static change on the line.

My invention relates to an automatic telegraph designed for rapid transmission and easy repetition of messages. It is founded upon the following general principles of construction, which are already known and made use of, viz: an indented fillet or sheet of paper or other non-conducting material, which, when passed under a movable terminal of an electric circuit, is made to actuate mechanically the said terminal to alternate contact and separation from the other terminal as the indentations successively pass under the movable terminal for the purpose of alternately opening and closing an electric circuit.

My invention consists in the combination of a spirally-grooved cylinder having a rotary motion, a jacket or strip of paper or other indentable material having indented characters therein and wrapped around said cylinder, and two terminals of an electric circuit, one of which is movable and is actuated to intermittent contact with the other terminal by traveling on the normal or plane surface of the paper, and separates from the other terminal by falling into the indentation in said strip of paper, the traverse of the groove by the movable terminal being effected either by the endwise movement of the cylinder or the movement of the terminals parallel to the axis of the cylinder, as hereinafter fully described.

In Fig. 1 of the drawings, A represents a cylinder having on its periphery a spiral groove, and having upon one of its journals a spiral thread of a pitch exactly equal to that of the spiral groove on the periphery of the cylinder, so that when the journal of the cylinder is fitted in an interiorly-threaded bearing and the cylinder is turned the cylinder has an endwise progressive movement in a right line, so that a relatively-stationary stylus on the periphery of the cylinder is made to traverse the groove therein.

B is a stylus, which is sustained by a spring mounted on the fixed support B′, and C is a stationary anvil attached to a spring immediately above the stylus, and mounted upon a fixed support, C′. This stylus and anvil constitute the two terminals of an electric circuit, as shown.

D is a jacket, sheet, or strip of paper, or other indentable non-conducting material, which is simply fastened about the periphery of the cylinder. This jacket is indented into the groove of the cylinder with Morse characters, by means of an indenting-point, *a*, worked by a relay, E, the said point being mounted upon one arm of an elbow-lever, as in Fig. 2, while the other arm carries the armature of the relay, and the relay serving to throw the point against the periphery of the cylinder, while a spring, *b*, withdraws it therefrom. This relay is worked by a Morse key in an independent circuit.

Now, for recording a message on the paper jacket and transmitting it the following is the method of working: The circuit of the relay is made and broken by the key in the usual way, either close at hand or at a remote point, and the relay is made to project the point against the paper jacket of the cylinder in accordance therewith, and as the cylinder rotates its groove in passing under the point of the relay permits the latter to indent a spiral row of Morse characters in the said paper

around the cylinder. Then, after the record has been thus made on the cylinder, the latter is run back, so that the beginning of the row of characters is under the stylus B, and the cylinder being now rotated and progressively moved under the stylus, the alternate indentation and intervening flat spaces cause the stylus to be alternately projected into contact with the anvil C of the other terminal, thus making and breaking the circuit in accordance with the record made. Thus, when the stylus drops down into an indentation, as in Figs. 3 and 4, the stylus B leaves the anvil C and breaks the circuit, and when the stylus rides up on the space intervening between the indentations and lying in the normal plane of the paper strip or jacket, as in Figs. 5 and 6, the stylus B is projected into contact with the anvil and completes the circuit.

This apparatus permits a message to be made and then transmitted without removing the paper from the place where its message is recorded, and makes a very desirable form of repeater, as the message recorded on the cylinder A may be received by the relay E from a distant station, and then, when transmitted through the stylus and anvil B and C, is sent to another distant station in an easy and practical manner, without mistake and without the aid of an expert.

In Figs. 7 and 8 is shown another form of my invention, in which the cylinder does not have an endwise motion, but simply revolves, while the relay with indenting-point and the transmitting-stylus and its anvil have a right-line movement parallel to the axis of the cylinder in traversing the groove of the same. For this purpose the indenting-relay and the transmitting-stylus are hung upon a screw-threaded counter-shaft, F, arranged parallel to the axis of the cylinder, and the screw-threads of which counter-shaft have such pitch that when the cylinder and counter-shaft are geared together by wheels, as shown, the rate of rectilinear progression of the relay and the stylus on the counter-shaft is exactly the same as that of the groove of the cylinder, so that when the cylinder revolves the stylus will traverse the groove from end to end. In this modification the indenting-point a' of the relay is forced inwardly to the cylinder by the spring b', and is drawn away from it by the relay, which is here shown in a local circuit, G, closed by the relay H. The main line I is also provided with a switch, J, which, when thrown on the point c, causes the main-line impulses to pass through relay H to ground, and by closing the local circuit operate the indenting-relay E. When the switch J is resting on the point d, relay H is cut out and the instrument is ready for transmitting, and as the cylinder revolves the stylus B, rising and falling in response to the indentation, alternately makes and breaks the circuit between I K B and C L.

Now, I am aware that it is not new to cause indentations in a piece of paper to actuate a movable terminal to intermittent contact with another terminal when said paper was disposed as a flat plane and the indentations were arranged as a volute-spiral. On the other hand, I am aware that a spirally-grooved cylinder has been provided with an indented tin-foil jacket, in which the tin-foil formed one of the terminals of the electric circuit. The objection to the first arrangement is that a volute spiral lying in the same plane makes a constantly-varying rate of travel, which is overcome in a spirally-grooved cylinder, and the distinction with respect to the second arrangement disclaimed is that when indented tin-foil constitutes one of the terminals the transmitting-stylus has to be carried with very great accuracy to prevent it from touching either the bottom or sides of the indentations, whereas with my invention, where a non-conducting sheet is used, the stylus may continually bear upon the paper and touch the sides and bottom of the indentations without risk of making a closure of the circuit.

Another advantage of my invention is (see Figs. 5 and 6) that when the stylus B is projected up to contact with the anvil C considerable lifting effect is required, and it will be seen that this lift is effected by the straight or plane surface of the paper at a^2 a^3, which paper is distended over a groove, as in Fig. 6, like a miniature suspension-bridge, and this lifting action is much more positive than would be obtained from an embossment, which, being narrow, would be crushed down by the weight of the stylus and the tension of its spring, and fail to make electrical contact above.

It is obvious that instead of using a non-conducting jacket for the cylinder a jacket of conducting material might be used, since its only function is a mechanical one, and not that of conduction.

For preventing induction on the lines or avoiding tailings or static change, currents of reversed polarity may be thrown upon the line alternately with the main impulses, as has been heretofore done. Thus, in Fig. 9, the stylus B, when elevated by the spaces between the indentations, makes contact with the terminal C of main battery, and when an indentation comes under the stylus the latter drops away from contact with C and makes contact with C', which is the terminal of a smaller battery of reversed polarity.

In defining my invention more clearly with respect to Edison's Patent No. 213,554, I would state that in the latter the modification referring to the use of a cylinder is substantially different from my construction, in that the cylinder is grooved longitudinally and not spirally, as in mine, and the cylinder is not the permanent carrier of the paper jacket, but the paper simply passes over the same tangentially from a separate roll. I therefore confine this part of my invention to the spirally-grooved cylinder and the permanent periph-

eral indentable jacket, in which the paper or indentable covering is not required to be removed from the cylinder between the time of making the record and transmitting it and the registration of the indented record with the subjacent grooves is preserved with accuracy and with the expenditure of no skill or labor.

With respect to the method of transmitting the electric impulses, Edison's tracer or stylus lifts the spring and breaks circuit when the tracer is passing over the surface of the paper not indented. In my method just the reverse takes place—i. e., the tracer or stylus makes or completes the circuit when the tracer or stylus is on the portion of the paper not indented. When the tracer, stylus, or movable terminal makes contact by descending into the grooves and striking against the other subjacent terminal, the said movable terminal must have an invariable or uniform and definite range of movement in descending in order to strike the subjacent terminal, and sometimes the movable terminal or stylus will (by wedging against the sides of the grooves or indentations in the paper when they are not wide enough, or striking against the bottom when they are not deep enough) fail to have that range of downward movement necessary to bring it into certain contact with the lower terminal, and the result is that the circuit is not closed when it should be. It is not possible to guard against this contingency by adjusting the lower terminal to a closer position to the movable terminal, because of the variable character of the grooves or indentations as to width and depth caused by the contraction of the paper after the grooves or indentations are made. Where, however, the circuit is closed by the elevation of the movable terminal against a superposed stationary terminal by the pressure of the non-indented surface or normal plane of the paper, a certain and positive closure of the circuit is obtained, because the normal plane of the paper always projects the movable terminal a fixed, uniform, and determinate distance, and the stationary terminal above may be adjusted to a position that insures contact and the closure of the circuit each time the movable terminal is lifted by the normal plane of the paper. Furthermore, in my case, as the opening of the circuit is made by the initial movement of the movable terminal in falling into the indentation, it matters not, for this action, whether the movable terminal moves a uniform distance or not.

Having thus described my invention, what I claim as new is—

The combination of a cylinder having a spirally-grooved periphery, a jacket having characters indented therein below the normal plane of the jacket, and two terminals of an electric circuit arranged upon the indented side of the jacket, and one of which is made movable and traverses the route of the indentation, the said movable terminal being thrown into contact with the other terminal by the non-indented portion or normal plane of the paper, and the said terminals and cylinder having a motion one over the other, as described.

The above specification of my invention signed by me in the presence of two subscribing witnesses.

JAMES WEBB ROGERS.

Witnesses:
EDW. W. BYRN,
SOLON C. KEMON.

368
(No Model.)

5 Sheets—Sheet 1.

C. C. REYNOLDS.

PHONOGRAPH.

No. 287,166. Patented Oct. 23, 1883.

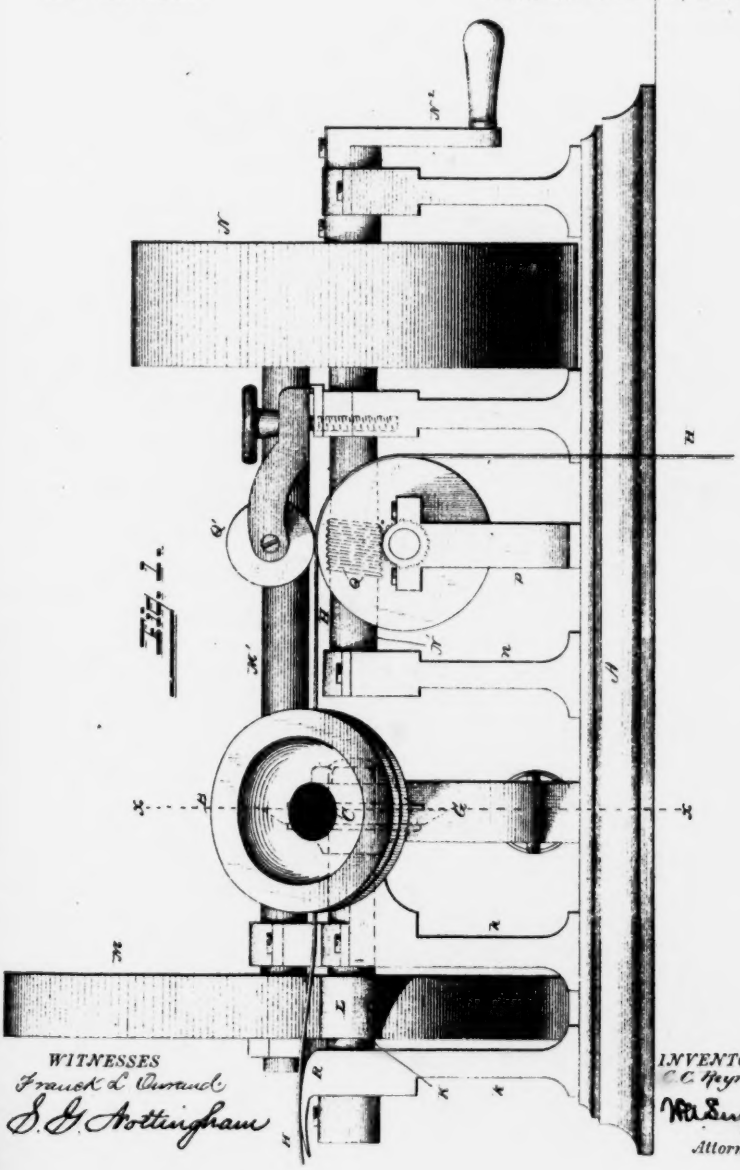


Fig. 1.

WITNESSES
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S. G. Nottingham

INVENTOR
C. C. Reynolds.
Wm. Simmons
Attorney

369
(No Model.)

5 Sheets—Sheet 2.

C. C. REYNOLDS.

PHONOGRAPH.

No. 287,166. Patented Oct. 23, 1883.

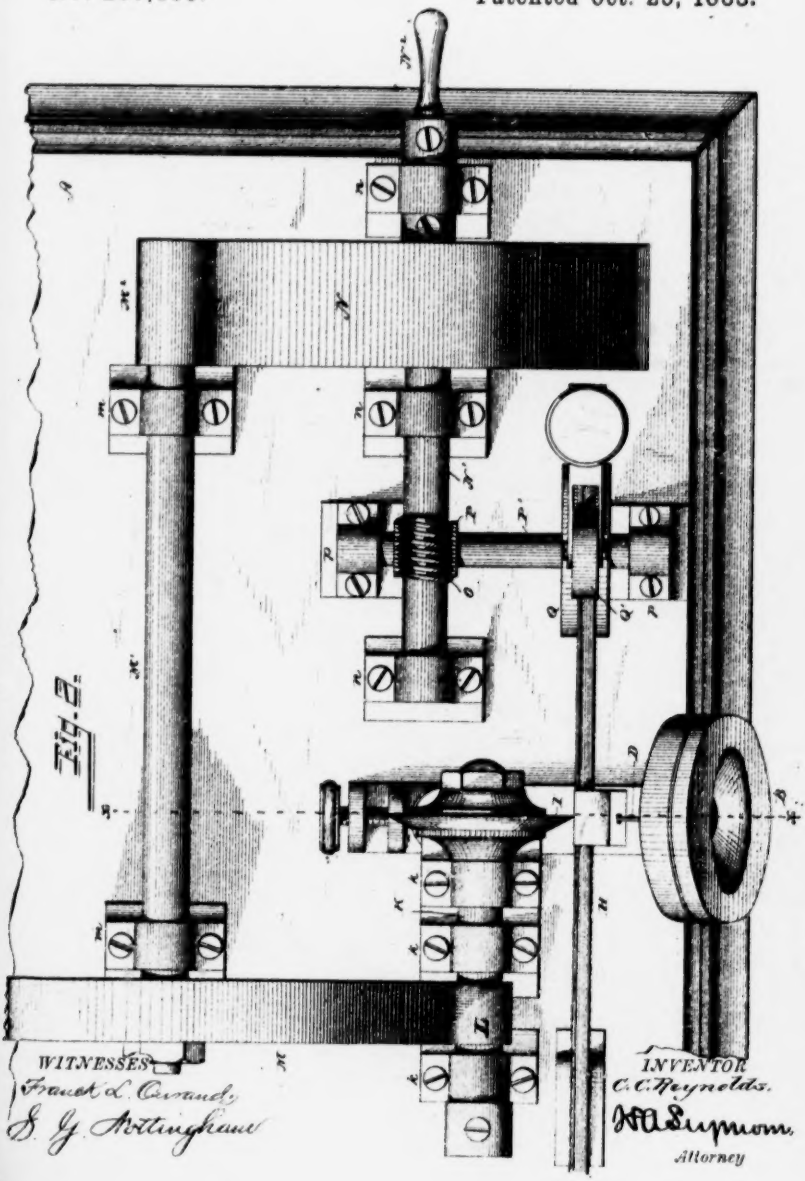

Fig. 2.

WITNESSES
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S. G. Nottingham

INVENTOR
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370
(No Model.)

5 Sheets—Sheet 3.

C. C. REYNOLDS.

PHONOGRAPH.

No. 287,166. Patented Oct. 23, 1883.

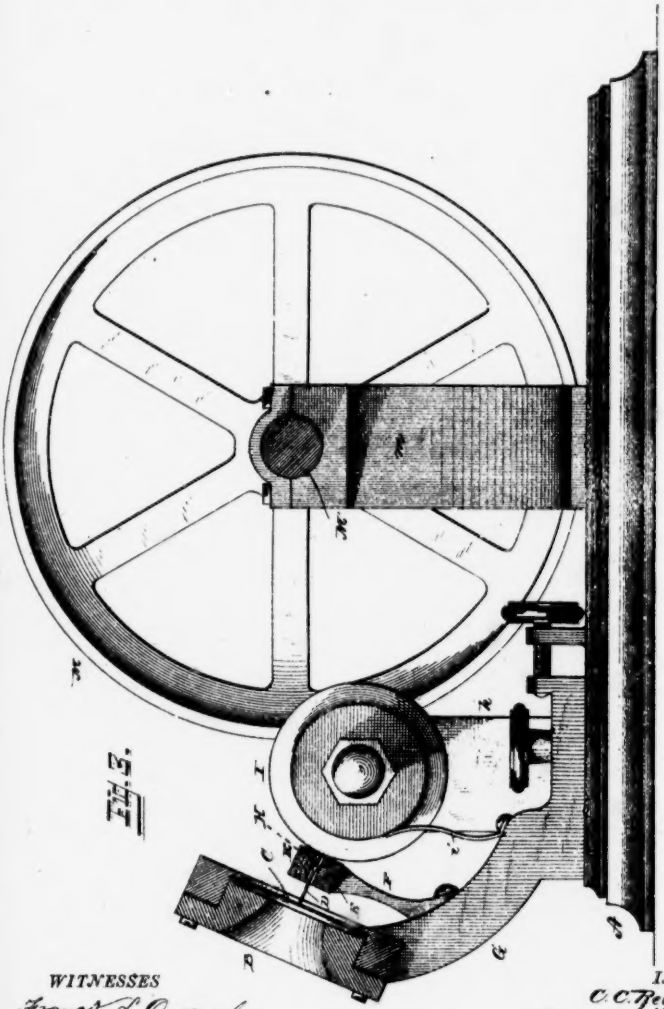

Fig. 2.

WITNESSES
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S. J. Nottingham

INVENTOR
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by A. A. Seymour.
Attorney

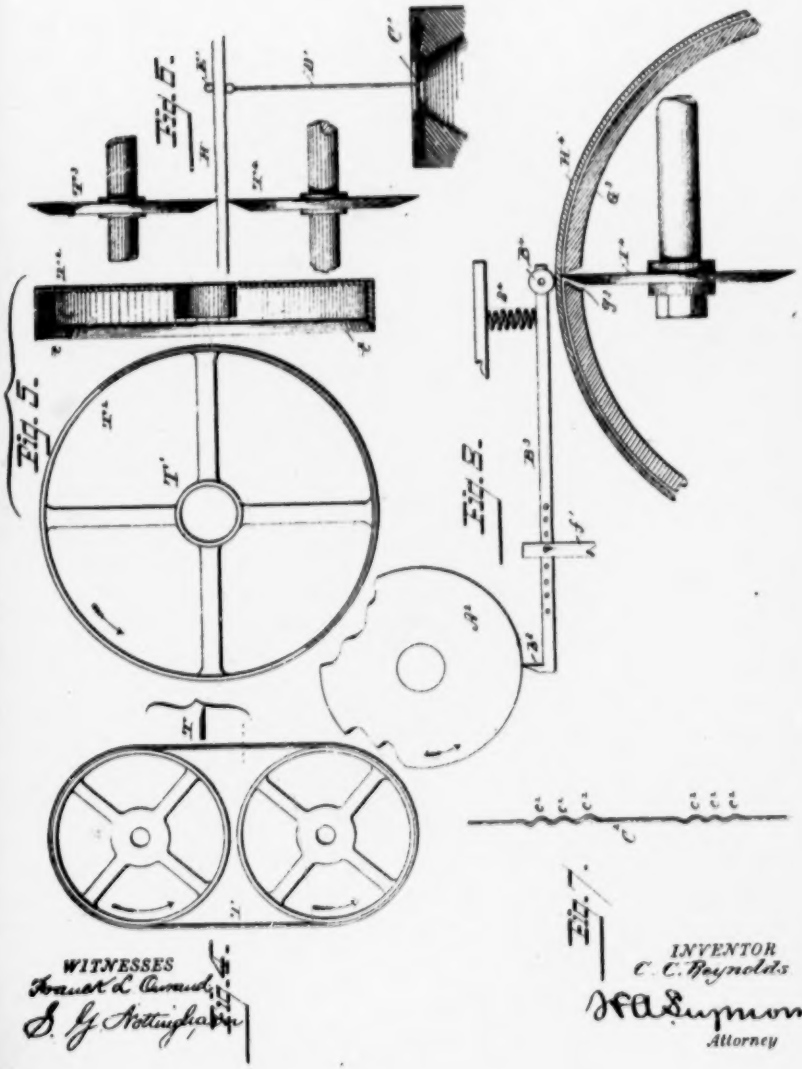
371
(No Model.)

5 Sheets—Sheet 4.

C. C. REYNOLDS.

PHONOGRAPH.

No. 287,166. Patented Oct. 23, 1883.



WITNESSES
Frank L. Ormsby
S. J. Nottingham

INVENTOR
C. C. Reynolds
by F. A. Lupton
Attorney

372
(No Model.)

5 Sheets—Sheet 5.

C. C. REYNOLDS.

PHONOGRAPH.

No. 287,166. Patented Oct. 23, 1883.

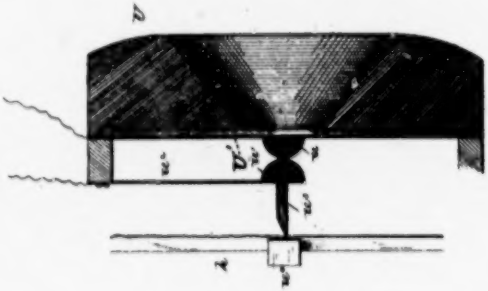


Fig. 9.

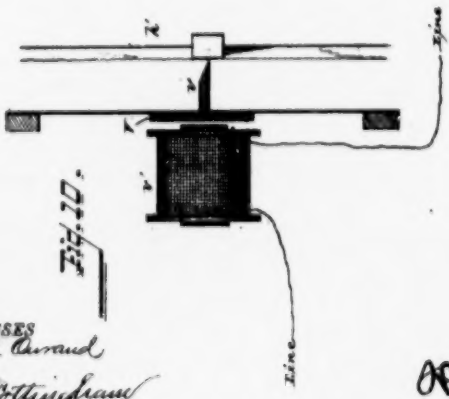


Fig. 10.

Fig. 11.

WITNESSES
Ernest L. Durand
S. G. Nottingham

INVENTOR
C. C. Reynolds.
by A. A. Seymour.
Attorney

UNITED STATES PATENT OFFICE.

CHRISTOPHER C. REYNOLDS, OF PRESCOTT, ARIZONA TERRITORY.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 287,166, dated October 23, 1883.

Application filed May 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, CHRISTOPHER C. REYNOLDS, of Prescott, in the county of Yavapai and Territory of Arizona, have invented certain new and useful Improvements in Phonographic Instruments; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in phonographic instruments, and methods by which are produced permanent records of sounds in such form that the sounds may be reproduced through the instrumentality of the records.

Instruments of this class as heretofore constructed have produced the sound-record by embossing or indenting a sheet of tin-foil or similar thin and pliable material, which is supported upon a revolving cylinder or plate to receive the action of a recording-stylus, which is forced directly against the sheet by a diaphragm vibrating in response to sounds, the said cylinder or plate being grooved spirally in order to permit the record-sheet to be forced into the groove to raise the record on one side of the sheet, while it is sunken or indented on the other side. The disadvantages of such an instrument are as follows: First, its capacity for continuous recording is limited by the dimensions of the cylinder or plate which supports the record-sheet; second, removing the sheet from its supporting plate or cylinder destroys the perfection of the record, as the embossing becomes more or less disarranged or obliter. d as the thin and soft sheet is subjected to the handling and bending necessarily incident to its removal; third, the embossing is so delicate and fragile that it is distorted by the action of a stylus, with which it is moved in contact for the purpose of reproducing the sounds, and consequently the reproduction is not exact; and, fourth, the resistance which the record-sheet opposes to the recording-stylus prevents the diaphragm from having an amplitude of vibration commensurate with the force of the sound-waves projected against it, and therefore the reproduction will not have the volume or loudness of the original sounds.

It is the object of my invention to provide a phonographic apparatus which is not subject to the disadvantages above enumerated; and to this end it consists in a new method and certain novel constructions and combinations of devices, which will be clearly understood from the following particular description, in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of a phonograph constructed according to my invention. Fig. 2 is a top view thereof. Fig. 3 is a section on the line *x x*, Figs. 1 and 2. Fig. 4 is a view in elevation and diametric section of a modified form of the record-cutter. Fig. 5 is a view in elevation and section of another modification of the record-cutter. Fig. 6 is a plan view of a portion of an instrument adapted to cut the record on both sides of the record-strip. Fig. 7 is a diametric section of a form of diaphragm adapted for use in my improved phonograph. Fig. 8 is a diagram illustrating the construction of an instrument for copying and amplifying an original record made by the old forms of instruments. Fig. 9 is a section of a portion of a telephone-transmitter adapted for transmitting sounds in connection with a record-strip produced by my improved instrument. Fig. 10 is a fragmentary section of another form of telephonic transmitter adapted for operation by the record-strip; and Fig. 11 is a view in cross-section of various forms of strips which may be used to receive the record.

In the drawings, the letter A indicates a base-board, upon which the various parts of my phonograph are mounted.

B is a mouth piece, in which is secured a diaphragm, C, in the manner usual in such instruments, and from the center of this diaphragm projects a stem, D, corresponding to the stylus of the ordinary phonograph. The outer end of this stylus plays between two guides, E E, supported by an arm, F, which projects from the adjustable standard G, which carries the mouth-piece. These guides E are arranged to receive between them the traveling record-strip H, which is guided across the edge of a rotary cutter-plate, I, which is carried by a shaft, K, mounted in bearings at the tops of standards *k*, rising from the base-board. Said shaft has also fixed upon it a friction-

wheel, L, which is driven by a larger friction-wheel, M, carried by a shaft, M', supported by standards *n*, and carrying at its opposite end a friction-pinion, M', which is driven by a main driving friction-wheel, N, carried by a shaft, N', which rotates in bearings on standards *n*. This shaft N' is provided with a worm-gear, *o*, which meshes with a tooth-pinion, P, mounted on a transverse shaft, P', supported by standards *p*, and having fixed upon it a friction feed-wheel, Q, over which passes the record-strip H, said strip being held properly in contact with the periphery of said feed-wheel by means of an adjustable pressure-wheel, Q'.

Near the opposite end of the base-board from the feed-wheel Q, and beyond the guides E E, is a guide, R, which also supports the record-strip and directs it properly between the guides E E. The record-strip, as shown in Fig. 1, is oblong in cross-section, as shown also at H in Fig. 11. It is to be made of a metal which will well support itself and resist ordinary wear—such, for instance, as copper, brass, iron, or soft untempered steel. The dimensions of the strip may be varied; but in practice a strip from one-eighth to three-sixteenths of an inch wide, and from one thirty-second to one-sixteenth of an inch thick, will be found to be of convenient size for general use. It is designed to cut into the edge of this strip indentations or notches corresponding to the record-indentation of the ordinary phonograph, this indented edge to be drawn in contact with a stylus connected with a reproducing-diaphragm in the ordinary manner, and thus reproducing the recorded sounds.

The operation of the apparatus as shown in the drawings will be readily understood. The record-strip H is first passed through the guide R, and then between the guides E in contact with the stem D, and on over the feed-wheel Q and under the pressure-wheel. The strip may be delivered from a suitable reel, (not shown in the drawings,) and after leaving the feed-wheel may be wound upon another reel, or disposed of in any desired manner. The guides and guide-wheel are so arranged that the edge of the strip H will lightly touch the edge of the cutter-wheel I. Now, when the shaft N' is turned by its crank N', motion is transmitted through the friction-wheel N, pinion M', shaft M', friction-wheel M, pinion L, and shaft K to the cutter-wheel I, which has a knife-edge of tempered steel. The relation of the devices for transmitting motion is such that even when the shaft N' is turned comparatively slowly, a very rapid rotary motion will be given to the cutter-wheel. At the same time that motion is being transmitted to the cutter-wheel from shaft N', said shaft also transmits motion through the worm *o*, pinion P, and shaft P' to the feed-wheel Q in the direction indicated by the arrow, and thus, while the cutter-wheel is rotating, the record-strip H is drawn across its edge, and if, while this operation is going on, sounds are produced in front of the diaphragm C, said diaphragm will be caused to vibrate and operate the stem D to drive the record-strip against the cutter-wheel I with a range and force of movement corresponding to the air-vibrations set up by the sounds, and the cutter-wheel will consequently cut notches or indentations into the edge of the record-strip which represent an exact record of such sounds.

It will be readily seen that the cutter-wheel opposes but a slight resistance to the movement of the record-strip, as it is so sharp and its movements so rapid that the edge of the record-strip is easily and rapidly cut away when it is passed against the cutter, even though the strip be of a material and bulk which enable it to sustain a considerable handling and friction when used for reproducing sounds, by drawing its indented edge in contact with a stylus arranged to operate a diaphragm.

It will also be seen that a record of indefinite length may be produced, or short records may be produced in rapid succession, by feeding strips of the desired length to the cutter-wheel.

In order to keep the cutter-wheel clear of particles of metal which might adhere to it, a light spring, *i*, is arranged to bear against each side of said wheel, so as to scrape off the adhering cuttings. This is a great advantage over the old forms of phonographs, in which, as is well known, the extent of the record is limited by the dimensions of the plate or cylinder which supports the foil-strip.

The sounds reproduced by a record-strip formed by my machine approach more nearly the original sounds in loudness and volume than do the sounds reproduced by the old forms of records, as by my improvement so little resistance is opposed to the movement of the strip that the diaphragm has a vibration much more nearly commensurate with the sounds projected against it than is possible when the record must be produced entirely by the force of movement of the diaphragm in driving the stylus against a record-sheet.

The record-cutter need not be limited in form to a simple rotary knife-edged disk. I have contemplated using a cutter operating after the manner of a band-saw, as shown in Fig. 4, in which the letter T indicates a steel band having one of its lateral edges beveled and sharpened to act upon the record-strip.

I may also use a rim-wheel cutter, as shown in Fig. 5, in which the letter T' indicates a spoked wheel having a rim, T', one of the lateral edges of which is beveled to a knife-edge, as shown at *t*.

I may also form the cutter-wheel with cutting-faces, similar to a fine file, to facilitate its cutting and smoothing of the edges of the notches; but such file-faces are not essential.

In Fig. 6 is illustrated a portion of an ir-

strument having two cutters, T' and T', between the edges of which the record-strip H passes, said strip passing also through a guide-eye, E', connected to the stem D', projecting from a diaphragm, C'. In an instrument thus constructed the complete vibration of the diaphragm in both directions is utilized for producing the record, complementary portions of the record being cut in opposite edges of the strip. If such a strip be drawn between a fixed stylus and a movable stylus attached to a reproducing-diaphragm, it is obvious that the two edges of the strip will co-operate in giving the diaphragm vibrations of extensive amplitude, and thus the reproduction of sounds will be very nearly as loud as the original.

In order to give the recording-diaphragm a capacity for free and prompt vibration, I have preferred to form said diaphragm with concentric corrugations, similar to the diaphragms of pressure-gages used for indicating steam-pressure. Such a diaphragm is shown in section in Fig. 7, in which C' indicates the diaphragm, and c' c' c' the corrugations. I have found such a diaphragm very sensitive and efficient in response to sounds.

The essential principle of my improvement may be utilized for reproducing, in durable and amplified form, the fragile records made by the old styles of phonographs. In the diagram Fig. 8 is illustrated the embodiment of my improvement in an apparatus for this purpose. The letter A' designates a cylinder which may be arranged to travel longitudinally, as well as to rotate in a manner similar to that of the cylinder of the old styles of phonographs. B' is a lever provided with a stylus, b', for acting upon an old record-sheet, which may be placed upon this cylinder. Said lever has an adjustable fulcrum, f', and at the end opposite the stylus carries a pressure-roller, B'. The letter G' indicates a supporting-table, against which the roller B' will be pressed by a spring, s'. This table has an opening at g', through which plays the edge of a cutter-wheel, I', which may be given a rotary motion by any suitable means. The letter H' indicates a record-strip, which may be drawn under the wheel B' and across the edge of the cutter-wheel, and if, while the said strip is so drawn, the cylinder A' be rotated, the record-strip thereon will vibrate the lever B' and cause the roller B' to press the record-strip in contact with the edge of the cutter-wheel with a varying pressure corresponding to the indentations of the record-sheet, which will be thus copied and given the form of a continuous strip. It is obvious that the copy may be much amplified by regulating the position of the adjustable fulcrum, so that the wheel B' will be carried by a long arm having any desired proportion to a shorter arm of the lever B', which carries the stylus.

The record-strips produced by my improved machine are peculiarly applicable for use in transmitting messages by telephone—as, for instance, should a person desiring to transmit a telephonic message be unable to send his message immediately and have no time to wait, he may prepare a record or message strip by one of my phonographs, and the telephonic operator may use the strip in transmitting the message at a future time, or in its regular order with other messages waiting until the line can be used.

In Fig. 9 the letter U indicates a portion of a telephonic transmitter which may be used for transmitting messages either directly by the voice or through the instrumentality of a record-strip. The letter U' indicates a diaphragm arranged in the mouth-piece in the usual manner, and provided on its rear surface with a carbon button, u, which is in contact with another carbon button, u', carried by a spring, s^2. The carbon button u' has projecting from its rear side a stylus, u^2, behind which is a guide, u^3, for a record-strip, h. The diaphragm U and the spring s^2 are supposed to be connected with the primary circuit of an induction-coil in the usual manner. It is not necessary to explain the manner of transmitting directly by the voice; but in case a record-strip, as shown at h, is to be used, such strip is drawn through the guide u^3, with its indented or record edge in contact with the tip of the stylus u^2, and will vibrate said stylus longitudinally, so that the pressure between the buttons u and u' will be varied in correspondence with the indentations of the strip, and thus the current varied in a manner to transmit the message represented by the strip.

In Fig. 10 is illustrated another form of transmitter, in which an armature, V, is provided with a stylus, v, to receive the action of a record-strip, as shown at h', so that said armature will be vibrated in front of the core of an electro-magnet, V', and induced undulatory currents be thus set up in the coil of the magnet in correspondence with the record, such induced currents traversing a line-wire and acting upon a receiver in the usual manner.

As before stated, the record-strip may be given various forms in cross-section—such, for instance, as illustrated in Fig. 11. H indicates the flat strip, oblong in cross-section, and with rectangular edges. H' is a strip triangular in cross-section. H² is a round strip. H³ is a flat strip having double-beveled edges, and H⁴ is a strip having sharp ribs to receive the action of the cutter. These strips may be made of any of the metals hereinbefore mentioned, or any durable material which will withstand the frictional wear and handling incident to their use. It will sometimes be found of advantage to make the record-strip of soft steel and temper or harden it after the record has been cut. Such a strip will obviously be extremely durable.

Having now fully described my invention and explained the operation thereof, I wish it to be understood that I do not confine myself to the precise details of construction shown in

my drawings and heretofore particularly described, but may vary the same in any manner for the better carrying out the essential principles of my improvement.

What I claim is—

1. In a phonograph, the combination, with means for moving a record-strip by sound, of one or more moving cutters arranged to act upon said strip, substantially as described, and for the purpose set forth.

2. In a phonograph, the combination, with the diaphragm and the moving cutter arranged to act upon a strip vibrated by said diaphragm, of feeding mechanism adapted to move a record-strip across the edge of the cutter, substantially as described.

3. In a phonograph, the combination, with the diaphragm and two moving cutters, of feeding mechanism adapted to move a continuous strip between said cutters, and intermediate devices for transmitting a vibratory motion to said strip from the diaphragm, so that the opposite edges of said strip will be alternately pressed against the cutters, respectively.

4. A phonograph-record consisting of a metallic strip having record-indentations of varying character representing sound-wave caused by articulate speech cut through one or more of its edges, substantially as described.

5. The herein-described method of preparing phonographic records, the same consisting in vibrating a record-strip by sounds and causing said strip to be cut during and in proportion to its vibration by a cutting-instrument operated independently of the diaphragm, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHRISTOPHER COLUMBUS REYNOLDS.

Witnesses:

GEO. W. CURTIS,

WILLIAM WILKERSON.

377
(No Model.)

4 Sheets—Sheet 1.

J. ABSTERDAM.

AUTOMATIC AND FAC SIMILE TELEGRAPH.

No. 295,219. Patented Mar. 18, 1884.

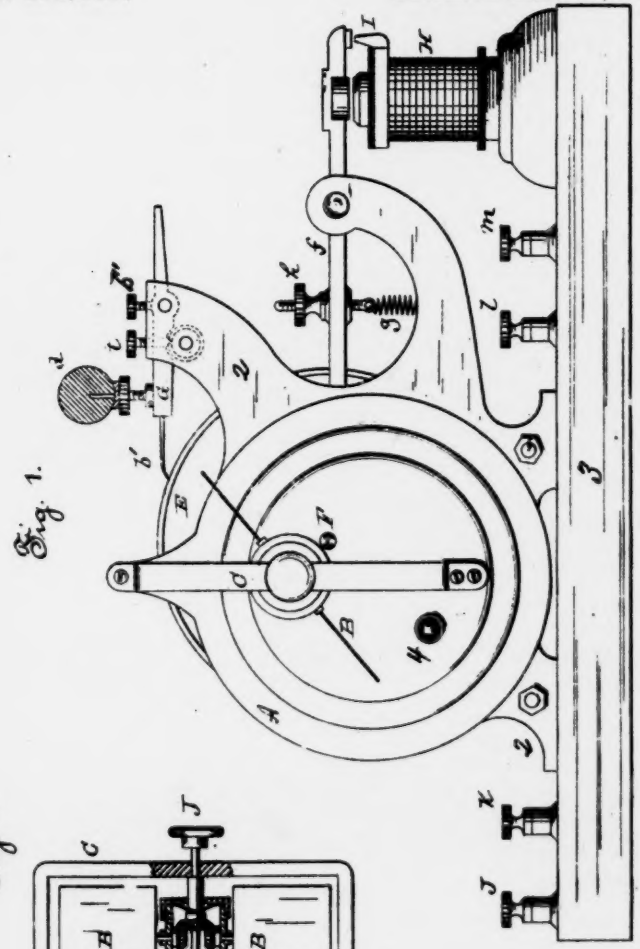


Fig. 1.

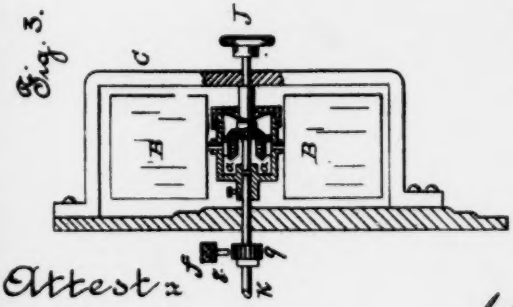


Fig. 3.

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(No Model.)

4 Sheets—Sheet 2.

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AUTOMATIC AND FAC SIMILE TELEGRAPH.

No. 295,219. Patented Mar. 18, 1884.

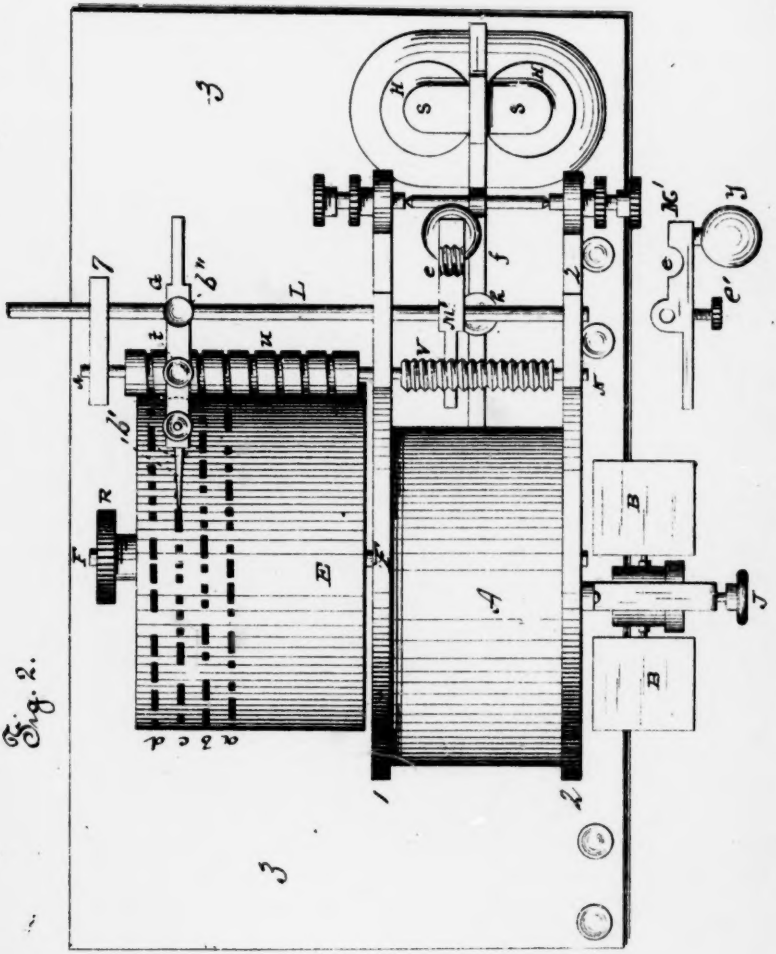

Fig. 2.

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(No Model.)

4 Sheets—Sheet 3.

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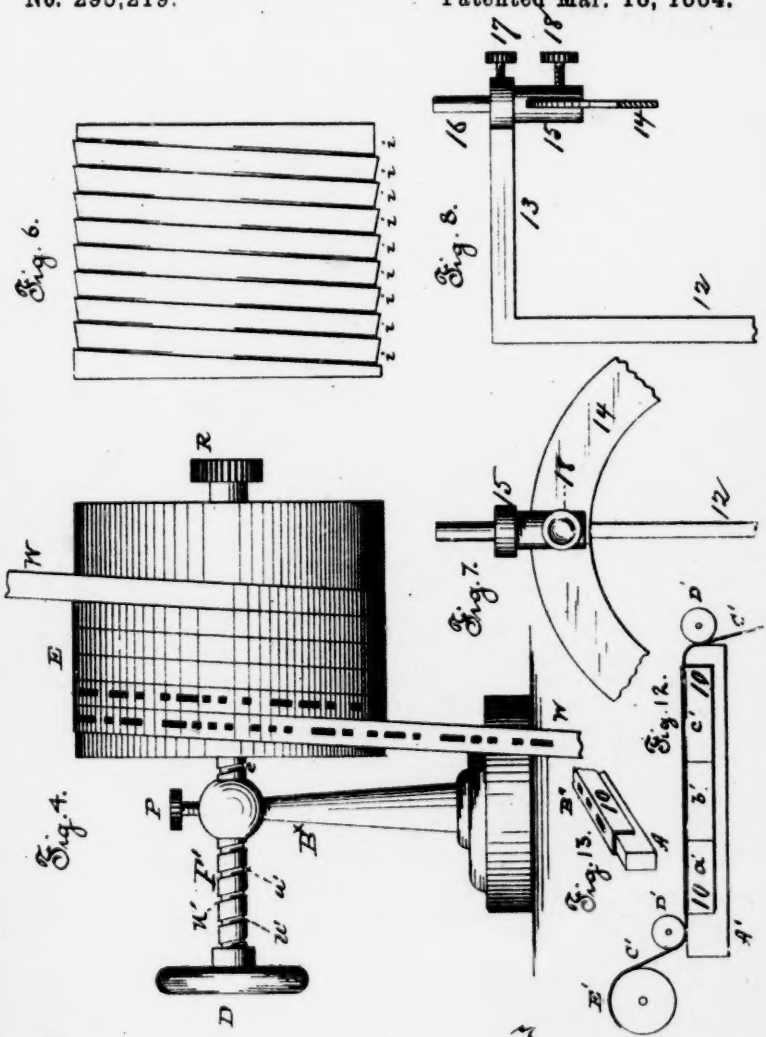
AUTOMATIC AND FAC SIMILE TELEGRAPH.

No. 295,219. Patented Mar. 18, 1884.



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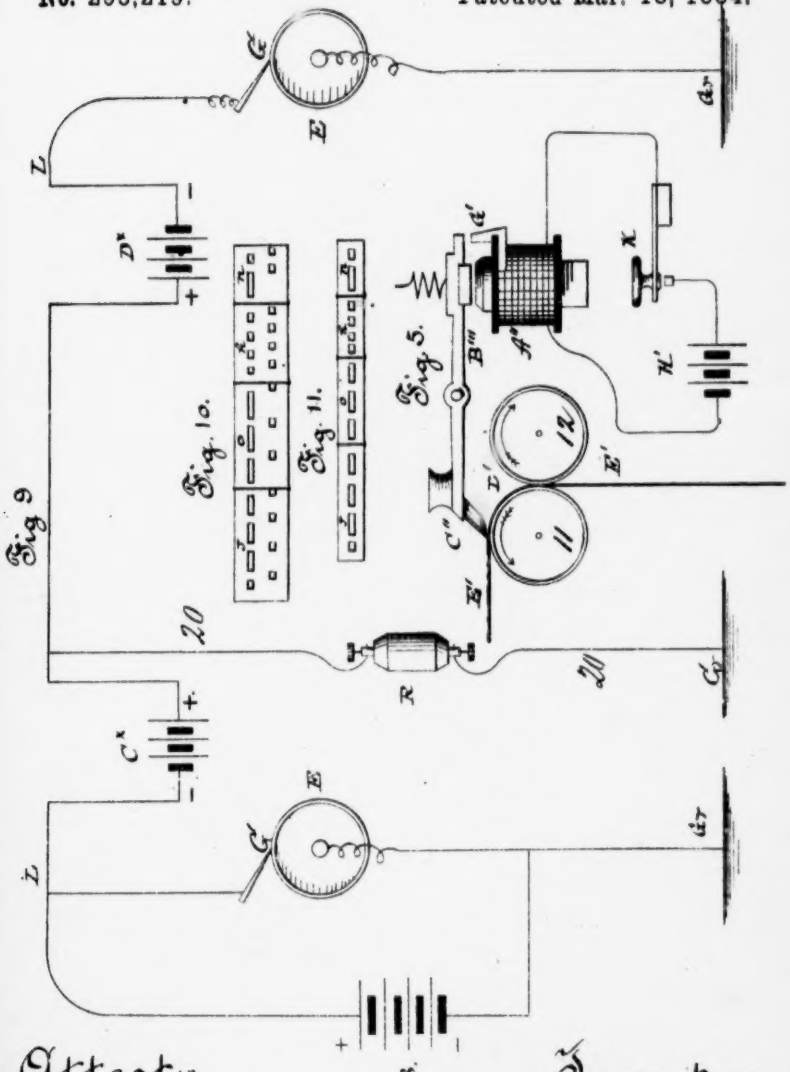
J. ABSTERDAM.

AUTOMATIC AND FAC SIMILE TELEGRAPH.

No. 295,219. Patented Mar. 18, 1884.



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UNITED STATES PATENT OFFICE.

JOHN ABSTERDAM, OF NEW YORK, N. Y.

AUTOMATIC AND FAC-SIMILE TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 295,219, dated March 18, 1884.

Application filed April 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN ABSTERDAM, of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Automatic and Fac-Simile Telegraphy; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates, generally, to improvements in that branch of telegraphy known as "automatic"—that is, wherein the mere transmission of the impulses necessary to indicate the message is not sent by hand, but the message is "composed" in or on some material or base, and the composed message is used to automatically control the apparatus transmitting the necessary impulses.

It more especially relates to improved, simple, and reliable means and methods for "composing" the message, means for transmitting the composed message, and to arrangements of circuits and batteries specially adapted to this class of telegraphy; and it consists in the features more particularly hereinafter described and claimed.

In carrying my invention into effect, I use as the base upon which the message is composed a perfectly smooth metallic cylinder or drum adapted to be placed upon or removed from a shaft, upon or with which it receives a rotary motion from any suitable prime motor, an adjustable fan-regulator being connected to the train, so that the speed of rotation of the cylinder or drum can be regulated and controlled.

For regular telegraphic transmission by any arbitrary code, the message-symbols are to be placed or composed upon the cylinder or drum in a regular spiral or winding line thereabout, with insulating material, either the insulated or the uninsulated portions representing the symbols, as may be desired. The spiral line of symbols may be placed upon the cylinder or drum in either of several ways. A paper fillet may be perforated in any well-known way, and the perforated band wound spirally around the cylinder or drum, and the surface then brushed over with the insulating ink or paint, the fillet serving as a stencil, so that when removed from the cylinder or drum the symbols appear thereon by the ink or paint reaching its surface through the perforations. If this system of stenciling be used, it is advantageous to use a blade which is an annulus whose interior diameter is that of the cylinder or drum adjustably mounted in a standard, the interior edge being then used to hold the perforated paper firmly on the drum or cylinder while the stenciling is in progress; or, upon a fillet of paper, the symbols may be marked in an ink or pigment which is both insulating and transferable, which strip of paper is then wound tightly upon the drum or cylinder, and the ink or pigment therefore transferred to its surface by the use of the proper dampness and pressure, or such other process as may be best adapted therefor. This strip of paper may be prepared for transfer by the use of stencils—that is, a set of stencils, each representing an arbitrary telegraph-symbol, is provided, each stencil being bent or hooked at each end, so that a number of them may be joined together to form a word or message. So joined together, they are laid upon the fillet and held thereon by suitable means, whereupon they are used as stencils to suitably mark the paper; or upon the free end of what would ordinarily form the pen or stylus of a Morse register may be mounted a broad-nibbed fountain or magazine or stylographic pen filled with the proper ink, the action of which would be to mark the symbols in broad dots and dashes of the insulating and transferable ink, instead of embossing the paper, as usual. Fillets or bands or sheets of paper prepared in either of these ways may be used as the agent for transferring the message to the face of the drum or cylinder. Instead, however, of transferring the symbols or matter to be transmitted to the surface of the drum, the strip itself may be wound thereon, it first having been prepared by any of the means noted—that is, with the matter stenciled thereon, or imposed by the register noted, or in any other suitable way. When the strip itself is used and wound around the drum or cylinder,

the ink to be used is preferably one not affected by water, either a fatty ink or a varnish not soluble in water, and properly colored, if desired, in order that it may show on the surface of the paper. A strip or fillet prepared with such an ink or varnish is saturated with water, the surplus water squeezed out in any suitable way—say by passing it through an ordinary wringer—and the strip or fillet then wound spirally around the drum or cylinder, with the symbols thereon uppermost. The web portion of the fillet or band becomes, through the agency of the moisture, conducting, while the fatty ink or the varnish forms insulating spaces, and the current through the transmitting device is thereby controlled.

If desired, in order to render it of greater conductivity, the water used to moisten the strip may be acidulated or impregnated with metallic salts in a manner well known in the art; or the symbols may be placed in a merely insulating ink on a metallized paper strip—that is, on paper having one side coated with a conducting metal—or even upon a metal foil. Such a strip is then wound on the drum or cylinder, its ends being fastened thereto by metal clips or by pasting, or in any other way which will securely hold it thereto. In this latter case any non-conducting ink will answer.

In order to facilitate the placing of the symbols in a regular spiral around and upon its face, the drum or cylinder may be provided with a fine spiral mark, engraved or cut therearound; or its face may be formed into a beveled spiral showing in cross-section a series of beveled grooves, the bottom of each being at a shoulder or wall rising to the top of the next; or the drum or cylinder may be placed upon a shaft capable of rotation in a suitable standard. This shaft is twice or more as long as is needed for the support of the drum or cylinder, and the part upon which the drum or cylinder does not rest is cut into a screw-thread of pitch corresponding to the pitch of the spiral upon the drum or cylinder. Into this screw-thread, through the box in which the shaft revolves, takes a pin or point. It follows, then, that if the drum or cylinder be rotated, and the fillet or other device used for placing the symbols thereon be fed thereto or used therewith at one point, a true spiral will be formed on the face of the drum or cylinder as it is moved forward during rotation by the action of the pin or point and screw-threaded shaft. I prefer a device of this kind for preparing the drums or cylinders for the work of transmission, instead of using one machine for both preparation and transmission, as thereby the more complicated and expensive transmitting machinery is left free to be employed at any time for its own uses.

The transmitting device consists of any suitable prime motor, suitably inclosed, gearing with and giving motion to a projecting shaft, upon and with which the drum or cylinder, prepared as hereinbefore specified, may be mounted and rotated. To this motor or some part of its train is connected a regulating-fan, the blades of which are adjustably connected to their shaft, so that their angle, and hence their resistance to rotation, may be varied or adjusted at will, whereby at will the speed of rotation of the shaft and the drum or cylinder placed thereon is regulated and controlled.

In the framing of the machine is mounted a rod capable of longitudinal movement in its bearings in the framing in a direction at right angles to the axis of rotation. Upon this rod is secured, so as to take upon the drum or cylinder, when desired, a stylus or pen. In the framing there has also its bearings a shaft, which receives a rotary motion by gearing connecting it with the prime motor of the transmitter. This shaft should be of twice the length of the cylinder or drum, and in that portion immediately adjacent thereto is screw-threaded, and with a pitch corresponding to the pitch of the spiral line of symbols upon the drum or cylinder. A pin, preferably a screw-point, passes through the body of the pen or stylus referred to and takes into such screw-thread. The result is that as both drum or cylinder and this shaft are rotated the pen or stylus passes across the face of the drum or cylinder, passing over the line of symbols thereon, and, if the proper line and battery connections be made, breaking and making or controlling the circuit in accordance therewith.

Thus far what may be termed a "merely automatic system of preparation and transmission" has been described. I have united therewith, however, means for using at will such a system, or a system of pure fac simile telegraphy.

The screw-threaded shaft referred to is, in the portion thereof not adjacent to the drum or cylinder, screw-threaded with a much finer pitch—indeed, a very fine pitch. Upon the longitudinally-moving shaft referred to there is mounted what may be called a "guide," capable of movement thereon, but also of being fastened thereto. It has formed upon its under side a half-nut, adapted, when thrown in proper position, to take into and be guided by the fine screw-thread noted. If, now, that be placed upon the drum or cylinder which it is desired to transmit in fac-simile, this guide is moved to its initial point, thrown into contact with the screw-threaded shaft, and fastened to the longitudinally-moving rod. The pen or stylus is fastened to the rod, but its pin or screw-point released from taking in the coarser screw-thread. Thereupon the pen or stylus is caused to traverse the drum or cylinder in a spiral of exceedingly-fine pitch, corresponding to the pitch of the finer screw-thread, making and breaking the circuit so often as to cause at the receiving end the re-

ception in fine parallel lines of a fac-simile of the message upon the transmitting drum or cylinder.

As this mechanism may be used for either transmitting or receiving, it is well to add to it a magnetic stop in the well-known manner of the Morse register—simply a magnet, the free end of whose armature takes into some part of the motor-train, and thereby stops it when the magnet is unchanged. The first make of the circuit or charging of the magnet, however, causes the attraction of the armature, releasing the train, while the resilience of the retractor of the armature and the magnetic force of the magnet are so adjusted relatively to each other that the magnet does not become sufficiently demagnetized to let go of the armature and cause a stoppage during the rapid pulsations used in automatic or fac-simile telegraphy.

The instrument thus far described has been described as a transmitter only. It may be used, however, as a receiver as well, and, in fact, in practice it is desirable to so use it. When used as a receiver, a strip of paper chemically prepared with any of the well-known solutions for that purpose is wound spirally around the drum; or a sheet of paper prepared in the same way may be fastened thereto. So prepared, the drum or cylinder may be rotated at a high rate of speed, avoiding the danger of breaking or tearing the fillet or band, which danger is always present when the fillet or band is merely passed between rollers or between a drum or roller and a stylus or pen. The stylus, in such case, is made merely as a fine metal point, in most cases of iron or steel, but varying as to material as the chemical composition of the material used with the receiving-paper varies.

In the exceedingly rapid work expected of these branches of telegraphy, if the circuit were absolutely made and broken as rapidly as the stylus can pass over the conducting and non-conducting portions of the drum or cylinder, a blurring of the received record would occur, due to prolongation of effect, caused by the extra or induced or earth currents in the wire itself. To obviate this, it is best to use an arrangement of circuits and batteries somewhat as follows: At each end of the line is placed a small battery, the two being connected to line, so as to neutralize, and the circuit being normally closed. At the transmitting end a third or main battery, more powerful than either of the other two, is connected to line around the transmitter, and in such manner that the transmitter forms a shunt-circuit away from the line for this battery, one end of this battery being connected both to the stylus and the line, and the other end of such battery having a connection to the ground and the drum, so that the connection between the battery and drum, when the stylus is on a conducting-space of the drum, forms the shunt-circuit, short-circuiting this battery from the line. When, then, the stylus is in contact with the metal surface of the drum or cylinder, a short-circuit for the main battery is established, so that it does not flow to line, while the two batteries directly in line neutralize each other. If, however, the electrical contact of the stylus and drum or cylinder is broken, the short-circuit of the main battery is broken and it is thrown to line. The two lesser batteries, though neutralizing each other, keep the line in a state of electrification, so to speak, and ready to be affected by any variation of potential at either end, while the circuit of the main battery never being broken, the current thereof being simply transferred from the shunt to the main circuit, or vice versa, sparks and extra currents are largely avoided.

In order to more completely avoid any effects of any extra induced or earth currents, one or more connections may be made from the line to the ground through large resistance—that is, through a resistance which the ordinary working-current would not overcome, but which the high-tension currents—such as are the extra or induced currents—would overcome.

By the means thus generally described I am able to furnish an exceedingly simple and reliable system of automatic telegraphy, uniting in one instrument capacity for code or fac-simile transmission, and requiring the least possible amount of skilled labor in its operation. In fact, by the use of the stencils noted, messages may be prepared at business houses or offices and sent to the telegraph-office ready to be transferred to the drum; or, as the drums are preferably prepared separately from the transmitting apparatus and then placed thereon, the drum itself may be fully prepared for transmitting by the customer and then sent to the operating-office.

It should have been noted that in preparing the messages a series or number of drums may be used, it being preferable that the drums or cylinders be prepared first and then placed in the transmitting apparatus. The preferable drum or cylinder is one made of zinc, and upon it the spiral guide-line before alluded to may be made with muriate of platina, which, in conjunction with zinc, gives a readily visible black mark. This process keeps smooth the surface of the drum and gives the needed indication without any indentation thereof.

It is preferable to coat the drums or cylinders used for receiving with a tinned surface, deposited thereon in any of the known methods of tinning, as tin withstands the corroding influences of the chemicals used and the current better than most, if not all, the commercially-practicable metals. These lines may be placed in a spiral for automatic transmission of code-signals or in straight lines for fac-simile or autographic transmission.

It may be noted, also, that the sources of current for the operation of the line may be dynamic or mechanical generators of current, instead of the batteries shown, the relations between the various generators or sources of

current used being preserved, as before noted. In fact, the various chemical, mechanical, and electrical conditions noted may be varied without departing from the spirit of the invention as hereinafter claimed. Several matters are herein shown or described not claimed herein, and no claim thereto is herein made because proper claim thereto has been made in a prior application or will be made in proper subsequent applications.

Convenient devices and arrangements for carrying my invention into practice are illustrated in the drawings, in which—

Figure 1 is a side and Fig. 2 a top view of the transmitter. Fig. 3 is a side view, partly in section, showing the arrangement for adjusting the blades of the fan-regulator. Fig. 4 is a side elevation of the device for supporting the drum while the latter is being prepared to control transmission. Fig. 5 is a side view, partly diagrammatic, of a device for preparing the transfer-paper by means of a pen. Fig. 6 is a view of a form of drum or cylinder which may be used in lieu of the drum shown in Fig. 4. Fig. 7 is a front and Fig. 8 a side view of a device for retaining the paper-fillet in position for stenciling on the cylinder or drum during stenciling. Fig. 9 is a diagram of the circuit and battery connection referred to. Fig. 10 and 11 are top views of the stencil-plates referred to, while Figs. 12 and 13 show convenient ways of using them.

In Figs. 1 and 2 of these drawings, which show the transmitter itself proper, 3 is any suitable base, on which are supported the framings 1 2, rising therefrom, between which is placed the casing A, containing the gearing or gearing and motive power for giving motion to the drum or cylinder E. While the motive power may be of any desired kind, it is here represented as a spring-power inclosed within A and having winding-place 4. Beyond the framing 1 extends a shaft, F, connected to and rotated by the gearing within A, upon which is to be placed the drum or cylinder E, which may be secured thereon so as to rotate therewith by the jam-nut P.

Upon a shaft, K, connected to the gearing within A so as to rotate therewith, and within a supporting-frame, C, attached to A, are secured fan-blades B B, rotated through the medium of bevel-gears *a a*, meshing with a bevel-gear and controlled by the thumb-piece J. By this arrangement the inclination or angle of the fan-blades B B to the plane of rotation may be varied, and hence the speed of rotation of them, the connected gearing, and the cylinder or drum E controlled and regulated.

Upon the cylinder E a representation of the matter to be transmitted is placed in alternate conducting and non-conducting spaces. These representations may be in the ordinary signs of any written language, or they may be, as shown in Fig. 2, the arbitrary or conventional signs of a telegraph-code. In the latter case they are to be laid around the drum or cylinder in a spiral line, as shown at *a b c d*, and by method and means to be hereinafter explained.

Supported by the framings 1 2 and a standard, 7, and capable of longitudinal movement in its bearings therein, is a rod, L, upon which is carried a stylus-holder, G, having a binding-screw, *b''*, adapted to fasten it to L. In the same framings, and between L and E, is supported a shaft, N, having gearings (not here shown) connecting it to the motor actuating E, so as to rotate proportionately therewith. Upon it is cut a screw-thread, *u*, of a pitch corresponding to the pitch of the spiral *a b c d* on E. Through G passes a screw or point taking into *u*. It follows, then, if the motor be allowed to act, that E and N will be rotated, and that the stylus-point *b'*, attached to G, will be carried across the face of the drum or cylinder, passing over the lines *a b c d*, and making and breaking circuit accordingly, if E and G be properly connected in circuit. The other extreme, however, of the shaft N is provided with a screw-thread, V, of much finer pitch than *u*—in fact, it should be of exceedingly fine pitch. Opposite it upon the rod L is what may be termed a "guide," M', having a screw, *e'*, to secure it, when desired, to L, but loose thereon when not secured by *e'*.

M' has formed in it a half-nut, *e*, adapted to take on the thread V. When the telegraphic symbols shown are to be transmitted, the screw *e'* is turned to loosen M' from L, and M' is thrown over from contact with V, as shown. If, however, a message in figure or language signs be placed upon E for fac-simile transmission, *t* is turned so that it does not take in *u*, and G is turned to secure G to L, at the same time M' is thrown over so that *e* takes on V and M' is fastened by *e'* to L, which, as before stated, is capable of longitudinal movement in its bearings. The parts being thus arranged, if the motor be started by the action of V *e* L G, the stylus *b'* is caused to traverse the face of E in a spiral of fine pitch corresponding to V, controlling the circuit accordingly. Thus I am enabled to furnish one instrument adapted to transmit at will either arbitrary telegraphic symbols or fac-simile or autographic messages.

In the circuit controlled by E and G is placed a magnet, H, having an armature-lever, *f*, and a back-stop, I, limiting its play. The lever *f* is provided with the usual retractor, *h g*, and its outer or free end is adapted and arranged, by a hook or stop, 8, when the lever is controlled by *g*, to take into a wheel, 9, of the motor-train, so as to stop or block the motor. The strength of H and *g* are so adjusted, however, relatively to each other that if H be overcharged, releasing, through *f* and 8, the motor-train, its residual magnetism will hold *f* during the rapid makes and breaks incident to automatic or fac-simile telegraphy.

It should have been noted before that by the adjustment of the regulator-fan blades B B the speed of the transmitter may be changed. In fac-simile telegraphy they may be so set as to allow the drum or cylinder to rotate much

faster than when it is used in ordinary automatic telegraphy. At the same time, if it be desired to prepare the drum while in the transmitter, they may be set so that its speed of rotation shall correspond with the speed of operation.

In order to give both G and M′ firm contacts with E and A, respectively, preventing any jumping or skipping, weights *d y* are provided. These weights may be applied as clearly shown in Fig. 1, where *d* is the weight applied to a projection, either screw-threaded or plain, from the body of the stylus-carrier G. This weight is so adjusted that it holds the pen or stylus firmly to the face of the drum or cylinder and obviates any liability to jump from the face or surface on which the end may rest.

The drum or cylinder for automatic transmission shown in Fig. 2 may be prepared in either of several ways. A strip or fillet of paper may be perforated to represent, either by the perforations or by the spaces between the perforations, any telegraphic code, and this by any of the well-known forms of perforators, as shown in Fig. 4. The strip so perforated is wound spirally around the drum or cylinder and used as a stencil for imprinting thereon marks or symbols corresponding to the perforations; or the strip or fillet of paper may be marked with an insulating and transferable ink or pigment in symbols representing a code, which strip or fillet may then be wound around the drum or cylinder and so treated that the ink or pigment is transferred from the fillet or band of paper to the surface of the drum or cylinder. A convenient means for accomplishing this is shown in Fig. 5, wherein 11 and 12 are rolls actuated to feed between them the strip, band, or fillet E′, while A″, B‴, H′, and K represent the ordinary construction of a Morse register. Upon the armature-lever B‴ is mounted a broad-nibbed fountain or reservoir pen, C″, which is lifted from or allowed to contact with E′, according as the circuit of H′ is made or broken by the key K. Instead of this, a set of stencils, each being the arbitrary symbol representing a word or letter in a telegraphic code, may be prepared, the ends of each stencil being bent over, so that a series may be hooked together, as shown in Figs. 10 and 11, wherein stencils representing J O H N are fastened together to form a word or message or part thereof. These stencils may be kept in stock, selected and joined to form the message by either the customer of the telegraph-line or by the employés thereof. They may, if desired, be formed with the shoulders 10. (Shown in Figs. 12 and 13.) Joined together, they are then used as shown in Figs. 12 and 13—that is, the paper band or fillet C′ is drawn over a support, A′, and held in position by rollers or clamps D′ D′, the stencils *a′ b′ c′* laid thereon, and the message stenciled on C′ in transferable insulating ink or pigment, and the strip C′ then used, as before stated, as the means by which the message is transferred to the drum E. By any of these means the drum E may be covered with a series of arbitrary telegraphic symbols in a spiral line. In order, however, to insure the correctness of the spiral line, and in order to at all times leave the transmitting apparatus free for its own particular work, I prefer to prepare the drum apart therefrom and place it in the transmitting apparatus only when fully prepared to control the sequence of makes and breaks necessary for complete and perfect transmission.

This can be accomplished by the use of the devices shown in Fig. 4, in which B‵ is a standard, having its upper end formed into a bearing or box for the shaft F′, which, for about half its distance, is screw-threaded, as shown at *s′*, the pitch of such thread corresponding to that of *s* on N in Fig. 2. A screw or point, P, takes through the journal or box into such screw-thread. Upon the shaft F′ the drum or cylinder is placed, and is secured thereon by the jam-nut R′. The shaft F′ is provided with a pulley or hand-wheel, D‵, by which it may be rotated. If, now, an end of the perforated fillet or band W be secured to E, and E be rotated by D‵, and the fillet or band fed thereto from one point, it is evident that it will be wound thereon in a spiral corresponding to *s* and *s′*. If desired to assist in this, the face of the drum or cylinder may be turned in a beveled spiral, as shown at *i i* in Fig. 6. The latter form affords a sure and simple guide for the spiral line, especially when the stencil-plates shown in Figs. 10 and 11 are used.

In order to retain firmly in place the stencils when in use, whether they be the perforated fillet or the plates, the device shown in Figs. 7 and 8 may be used, wherein 12 is a standard having a projecting right-angled arm, 13, in the end of which is supported, by means of its shank 16, a slotted piece, 15. In the slot of 15 is secured, by means of the set-screw 18, the blade 14, which is an annulus, its interior diameter being equal to the diameter of the drum or cylinder. The blade is adjusted by the set-screw 17, so as to bear upon the stencil, when placed on the drum or cylinder, and so hold it firmly while it is being brushed over.

By the means described, the drum or cylinder may be readily and reliably prepared to control automatically the transmission of the desired matter, and that with a minimum of skilled labor.

For transmission, the arrangement of circuits, batteries, and instruments shown in Fig. 9 is a desirable one, in which at the receiving and transmitting stations the drums or cylinders E E and pens G G are conventionally represented, the drums or cylinders being connected to the ground Gr, while the styluses or pens are connected to the line. At each end of the line is a weak battery, these batteries being indicated at C‵‵ and D‵‵, of equal strength, and connected oppositely in the circuit, so as normally to neutralize. At the

transmitting-station a stronger and main battery, M B, is connected to line, so as to re-enforce C^5, and to ground around the transmitting apparatus E G. In the line between the stations is made a ground-connection, 20, having in it a rheostat, R, of such resistance as to prevent the ordinary working battery-currents from going to earth. Normally the batteries C^5 D^5 neutralize each other, keeping the line in a neutral state so far as electrical tension is concerned. When the transmitter is used, as the pen G rests on a metallic portion of the drum or cylinder E, the main battery M B is short-circuited. When, however, electrical contact between E and G is broken by an insulating-space, the short-circuit of M B is broken and its current is forced to line and distant station, to complete its circuit. As its circuit is never broken, but merely changed, the danger of false marks from prolongation of discharge is largely obviated, while the resistance-leak 20 and R (of which there may be any desired number in the circuit) affords a short path to ground for any extra or induced currents, so that they are not compelled to pass through and affect the receiving-instrument.

I do not herein claim, broadly, a method of automatic transmission consisting in causing the ordinary symbols of a telegraph-code to be recorded in insulating and conducting spaces upon a suitable surface, and then using the record so made to automatically control the transmitting-circuit; nor the combination, with one transmitting-surface, of a motive power and a regulator adapted to vary and control the speed of movement of such transmitting-surface, and means for controlling the regulator at will, as such subjects-matter of invention form the subject of a prior application, bearing serial number 88,352; but,

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an automatic-telegraph transmitter, the combination of a drum or cylinder having symbols thereon in non-conducting matter in a spiral line, and representing a telegraphic code or signals, a stylus, and means, substantially as described, for causing the stylus to contact with the drum or cylinder when in operation and take upon the drum and the lines of non-conducting symbols, substantially as set forth.

2. In an automatic-telegraph transmitter, the combination of a pen or stylus, a drum or cylinder having thereon symbols of non-conducting material in a spiral line therearound, and means for rotating such drum or cylinder, and means for causing the pen or stylus to traverse the drum or cylinder in a spiral line, substantially as set forth.

3. In an automatic-telegraph transmitter, a drum or cylinder having a series or number of symbols representing a telegraphic code or alphabet imprinted thereon in non-conducting matter, and in a spiral line therearound, to automatically control the transmission of the electrical impulses necessary for a message, substantially as set forth.

4. In an automatic-telegraph transmitter, the combination of a drum or cylinder, a stylus or pen, and a shaft provided with two different screw-threads and a guide, so that the path of travel of the stylus over the face of the drum or cylinder may be changed, substantially as set forth.

5. In an automatic-telegraphic transmitter having a drum or cylinder prepared in spiral lines of conducting and non-conducting material, to control the transmitting-circuit, the combination, with the drum or cylinder, of a motor giving motion thereto, a vibrating or governing fan for controlling the speed thereof, and means for simultaneously adjusting the position or angles of the vanes of the fan relatively to each other, and locking them positively in such position or relation, so as to readily control and regulate the speed of the motor and of rotation of the drum or cylinder, substantially as set forth.

6. A stencil-plate or series of stencil-plates, each representing an arbitrary telgraph-symbol, and provided with hooked ends adapting them to be joined together to form a message, substantially as set forth.

7. The means for holding the stencil in position upon the face of the drum or cylinder while in use, consisting of an upright and its right-angled arm and an adjustable annulus supported thereby, substantially as set forth.

8. The method of automatic transmission herein described, consisting in causing telegraphic symbols to be recorded upon a drum or cylinder in conducting and non-conducting spaces in a spiral line by transferring or stenciling thereon a suitable ink, paint, or pigment, and then using the record so made to automatically control the transmitting or line circuit, substantially as set forth.

This specification signed and witnessed this 16th day of April, 1883.

JOHN ABSTERDAM.

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(No Model.) 4 Sheets—Sheet 1.

C. A. BELL & S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214. Patented May 4, 1886.

Fig. 1.

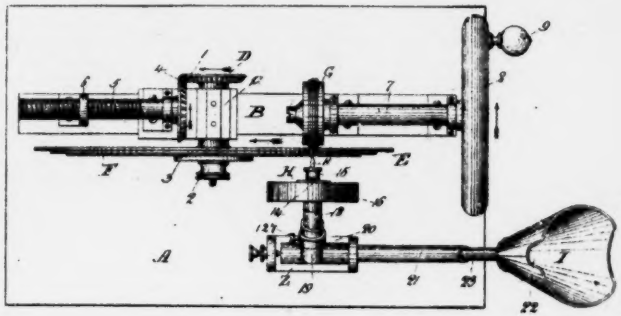


Fig. 3.

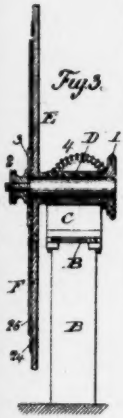


Fig. 2.

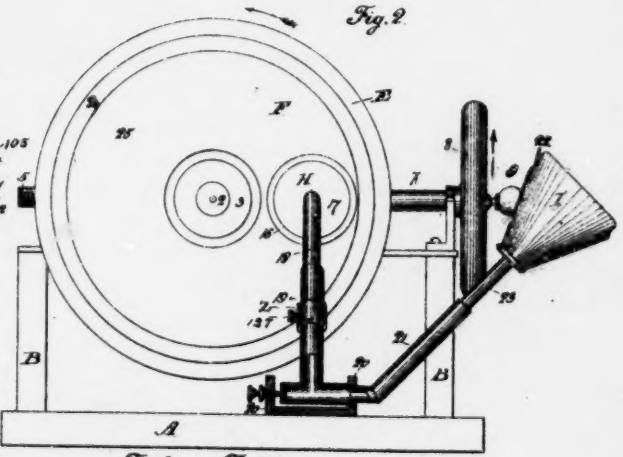


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 9.

Fig. 8.

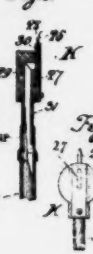
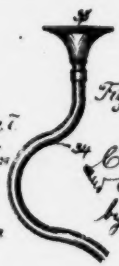


Fig. 10.

Fig. 7.

Fig. 11.



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(No Model.)

4 Sheets—Sheet 2.

C. A. BELL & S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214. Patented May 4, 1886.

Fig. 12

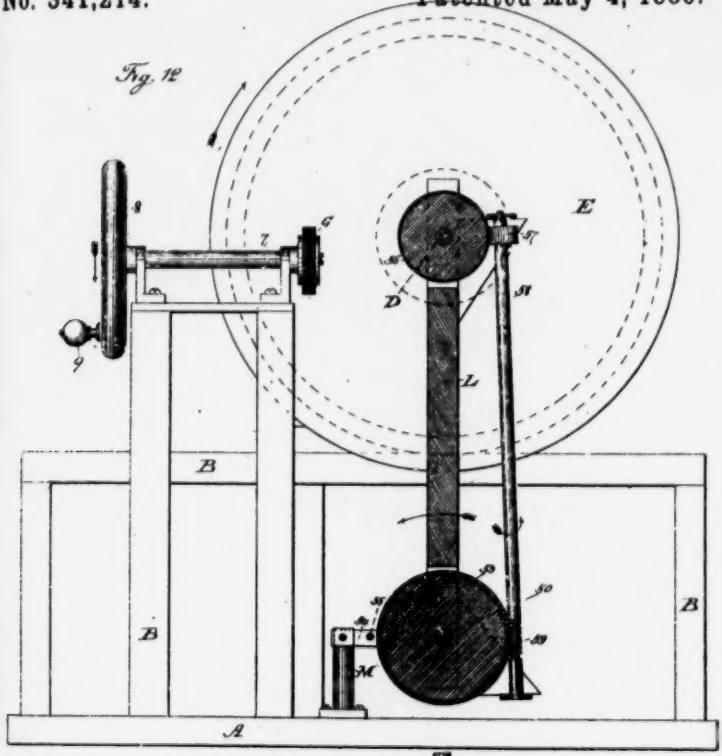
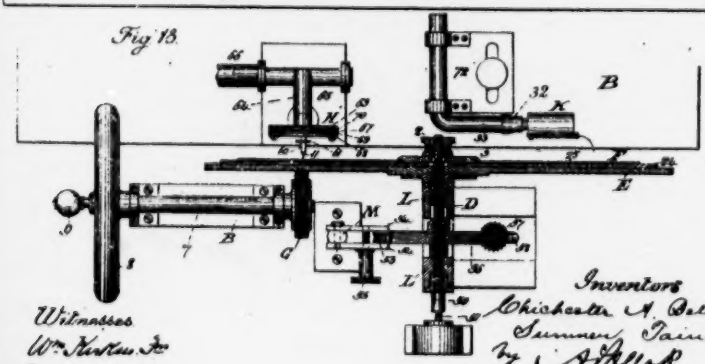


Fig. 13.



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(No Model.)

4 Sheets—Sheet 3.

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RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214. Patented May 4, 1886.

Fig. 14.

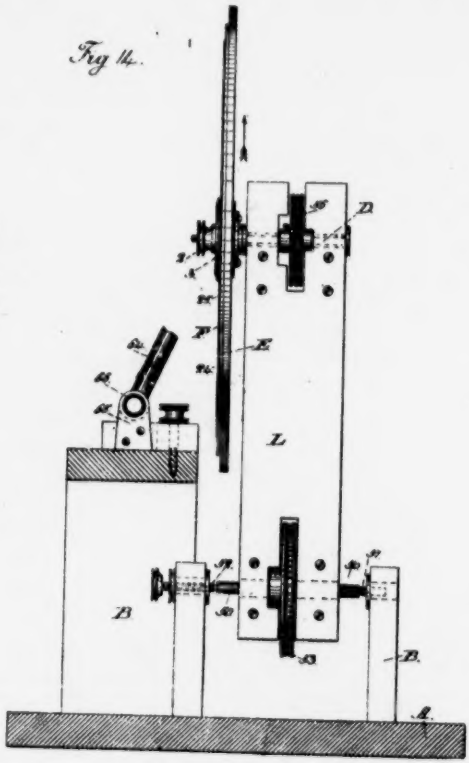

Fig. 21.

Fig. 15

Fig. 16

Fig. 17.

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(No Model.) 4 Sheets—Sheet 4.

C. A. BELL & S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214. Patented May 4, 1886.

Fig 18.

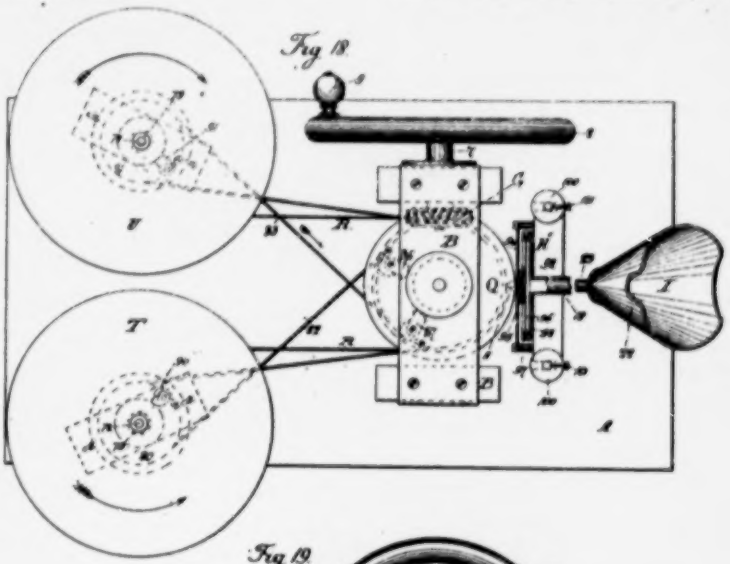


Fig 19.

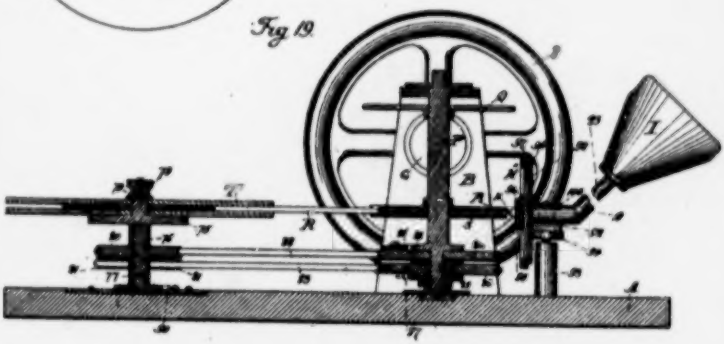
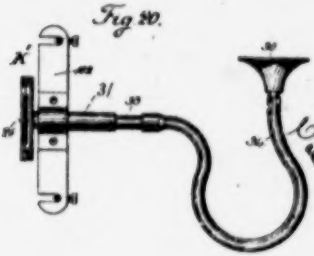


Fig 20.



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UNITED STATES PATENT OFFICE.

CHICHESTER A. BELL AND SUMNER TAINTER, OF WASHINGTON, D. C.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

SPECIFICATION forming part of Letters Patent No. 341,214, dated May 4, 1886.

Application filed June 27, 1885. Serial No. 169,041. (No model.)

To all whom it may concern:

Be it known that we, CHICHESTER A. BELL and SUMNER TAINTER, both of Washington, in the District of Columbia, have invented a new and useful Improvement in Recording and Reproducing Speech and other Sounds, which improvement is fully set forth in the following specification.

This invention relates to the formation, in a solid substance, of elevations and depressions, or other inequalities corresponding more or less perfectly to the forms of sound-vibrations, and the reproduction, by means of such inequalities, of the sounds represented by them.

The invention consists, first, in the formation of the record or "phonogram," as it has been called, by means of a cutting-style which is vibrated by the sound-waves or sonorous vibrations to be recorded. The vibrations may be impressed upon the style directly by the impact of the sound-waves upon some device mechanically connected with or carried by the cutting-style or its support, or indirectly through the action of an electric current or other suitable vibratory medium. Heretofore a large number of contrivances have been devised for converting electrical impulses into mechanical vibrations, and they could, of course, be used for vibrating the cutting-style. Otherwise they have no relation to this part of the present invention, the essential new feature of which is the removal of material to form the record by a cutting, gouging, or graving action of the vibrating style. Heretofore the vibrating style has, as in Edison's well-known phonograph, simply indented the recording material. It has been proposed to cut the record in the edge of a strip of metal or other solid material by vibrating the strip in contact with the cutting-edge of a rotary disk cutter; but this proposal is essentially different from this invention, the new mode being applicable to cutting the record upon all sorts of surfaces, and not upon strips only, and is, besides, believed to be later in time than this invention. Under this part of the invention are included the vibratory cutting-style as a new device in a sound-recorder, and the combination of the same with other devices; also the cut or engraved record itself. In this new or improved form of record not only may a larger number of words or sounds be recorded in a given surface than has been practicable with the indented records heretofore in use, but the recorded vibrations are also sharper and better defined. It is found that an indenting style smooths over the crests of the larger elevations, and also rubs out some of the finer ones.

The invention consists, secondly, in engraving or cutting the record in a waxy or amorphous, and slightly cohesive substance. Preferably, a compound of beeswax and paraffine (the latter in excess) is employed. This compound has no tendency to clog the style, but is readily removed thereby in chips or shavings. This part of the invention also consists in a recording material composed of a wax or waxy surface on a paper or pasteboard foundation. Heretofore it has been proposed to use soft paper saturated or coated with paraffine as the material for recording by the indenting method; but its use does not appear to have been successful, and an outer layer of tin-foil was therefore employed to receive the indentations.

The invention consists, thirdly, in cutting or engraving the record in the form of a groove with sloping walls, the sound-waves being represented by elevations and depressions at the bottom of the groove or otherwise. The advantage of this form of record is that it forms an efficient guide to the reproducing-style.

The invention consists, fourthly, in loosely mounting the reproducing-style so that it can readily be guided by the record. Preferably the reproducing-style, or rather what may be called the "head" of the reproducing instrument is mounted on an universal joint, and the style is pressed against the record by the yielding pressure of a spring or weight. Practically in the instruments made by us the pressure is due to the weight of the instrument, modified by the elasticity of a section of soft-rubber tube, which supports the same and constitutes a universal joint; but evidently there are many devices which can be used to mount the reproducer, so that it is free to follow the sound record or phonogram, and which, therefore, would be within the spirit of the invention. The reproducing-style, mounted as just explained, is specially adapted for use in connection with a record in the form of a groove with sloping walls, and this

combination is specially claimed; but it may also be usefully employed in connection with other forms of record.

The invention consists, fifthly, in reproducing directly from the wax record. It is found that such a record has sufficient strength to withstand the rubbing action of the reproducing-style, so that a considerable number of reproductions can be obtained from it. The smoothness of the wax gives it a great advantage in this regard. So far as we are aware, no one has reproduced sounds from a wax record by rubbing a style or reproducer over it.

The invention consists, sixthly, in a reproducer or reproducing instrument in which the reproducing-style, instead of being placed behind its support, projects at the point beyond the edge thereof. One practical advantage of this is that it enables the position of the style on the record or phonogram readily to be observed.

The invention consists, seventhly, in cutting the sound-record in a fusible material, (the waxy compound before referred to, for example,) and then melting the surface slightly, so as to remove any roughness left by the cutting-style. These roughnesses are altogether outside of the sound-vibrations, and give rise in reproducing to scraping noises, which interfere with the intelligibility of the sounds reproduced. These scraping noises are greater with some other modes of reproducing which we have devised, and which will form the subject of other patents, than they are with a rubbing style; but even with the latter the additional smoothness given to the surface by the partial fusion has some advantage.

The invention consists, eighthly, in a sound-recorder having a cutting or graving style which is held by elastic or yielding pressure against the surface on which the record is to be made. The object is to enable the vibratory graver or cutting style to ride over instead of plowing through any elevations on the recording-surface. The depth to which the point of the cutting-style is embedded in the record affects the amplitude of the style's vibration. By this improvement the depth is kept uniform, notwithstanding any slight unevenness of the recording-surface.

The invention consists, ninthly, in having the recorder, of whatever description, or the reproducer, or both, rest against the tablet or recording material by gravity.

The invention consists, tenthly, in combining, with a sound-recorder or recording-instrument of any suitable description, and specially with one having a cutting-style, a tube or hollow standard on which the recorder is mounted, and through which the sound-waves are conveyed to the same. This part of the invention also consists in supporting this hollow standard on a hinge, and having a sound-conveying tube communicate with the interior thereof through the hinge. This part of the invention further consists in supporting the reproducer or reproducing-instrument on a hollow sound conveying standard, the same as explained with respect to the recorder, and in similarly connecting the hollow standard of the reproducer with an exterior sound-conveying tube.

The invention consists, eleventhly, in combining with the recorder a mouth-piece so shaped as to include the nose of the user. It is found desirable to concentrate the sound-waves as much as possible upon the recording instrument or style, and if an ordinary mouth-piece be used the sound reproduced from the record is imperfect in the nasal elements, and sounds somewhat like the speech of a person with a cold in his head. By the use of the improved mouth-piece this disagreeable quality of the reproduced sound is avoided.

The invention consists, twelfthly, in a reproducer in which the sonorous vibrations impressed by the record upon the style are by the latter communicated to a block, plate, or other body of hard rubber, and through said body are transmitted to the air or to other vibratory medium. It is found that this material (hard rubber) gives much purer sounds than metal and other substances heretofore employed. It appears to absorb minute vibrations which give rise to scratching noises, and also to communicate sonorous vibrations without at the same time adding any foreign vibrations due to the movements of its own particles among themselves. The result is probably due to the high elasticity and the homogeneity of hard rubber.

The invention consists, thirteenthly, in combining with the disk of a recording and reproducing apparatus, in which the record is formed on the face of said disk in a volute or spiral by cutting or otherwise by any known or suitable means mechanism for giving to said disk a uniform surface-speed under the recorder. Heretofore when the record was formed on the face of a disk the latter has been given a uniform rotation, so that the same number of words were recorded in the outermost circles, as in the smaller inner ones. By giving to the disk a uniform surface-speed under the recorder, or by making the times of each rotation inversely proportional to the distance of the recorder from the center of the disk, the record of any given word or sound will be of the same length at whatever part of the disk it may be, and in this way it is possible considerably to increase the number of words or sounds on a given area.

The invention further comprises certain special constructions, combinations, and arrangements of parts, as hereinafter set forth.

Having now explained the principle of the invention, the manner in which the same is or may be applied will now be explained with reference to the accompanying drawings, which make part of this specification.

Figure 1 is a plan view of an apparatus constructed in accordance with the invention, arranged for recording; Figs. 2 and 3, respectively, a front elevation and cross-section of

the same; Fig. 4, a view in section and elevation of the recorder; Figs. 5 and 6, views on an enlarged scale of the graver or cutting style; Figs. 7 and 8, views in elevation and section, respectively, of the reproducer; Figs. 9 and 10, similar views of another form of reproducer, and Fig. 11 an elevation of the sound-conveying tube for use with the reproducer. Figs. 12 to 17 represent a modified form of apparatus, Fig. 12 being a back view, partly in section; Fig. 13, a plan, partly in section; Fig. 14, an edge view, partly in section; Figs. 15 and 16, views in elevation and section of the recorder, and Fig. 17 an edge view of a friction-clamp making part of the apparatus. Figs. 18 and 19 are plan and longitudinal sections, respectively, of a form of apparatus also constructed in accordance with the invention, or with parts thereof in which the record is made on a strip, and Fig. 20 a plan, partly in section, of the reproducer for use with such apparatus. Fig. 21 is a view of a recorder in which the style is operated electrically.

Referring to Figs. 1 to 11, A is the base or bed of the apparatus, and B an upright frame, which carries the mechanism for supporting and moving the tablet F, (shown as a disk,) on which the record is to be or has been formed. In the slide C, movable in ways of the frame B, is journaled an arbor, D, on which are fixed a metal disk, E, at one end and a bevel-gear, 1, at the other. The arbor projects beyond the metal disk E, so as to form a support for the recording-tablet F, which is retained thereon by the nut 2 and washer 3. The metal disk E performs the double function of a friction-wheel and of a backing to the recording-tablet F. The bevel-gear 1 engages a similar gear, 4, on the end of the screw 5, which is journaled in a bearing in the slide C, and is tapped through a stationary lug, 6, on the frame B. As the arbor D is revolved, the screw 5 is turned also, and in consequence of its engagement with the lug 6 it moves the slide C lengthwise of the frame B. The rotation is communicated to the arbor from the shaft 7, journaled in bearings of the frame B, and provided at one end with a fly-wheel, 8, and crank-handle 9, and at the other with a friction-pinion, G. This pinion is formed, as shown, of rubber disks clamped together between metal washers. It bears against the back of metal disk E, and communicates motion to it. As the slide C is moved by the action of the screw 5, the metal disk E is carried past the friction-pinion, so that it touches the metal disk in a spiral line, and serves to give a uniform surface speed to each part of the disk as it in turn comes opposite said pinion. The recorder H is placed on the opposite side of the metal disk E, preferably as shown, with the point of the graver or cutting style 11 directly opposite the point where the pinion G touches the disk E. The said pinion thus acts as a support to the disk against the action of the cutting or recording style. The latter is preferably formed of a round wire by turning the end conical and rounding the extremity, and then grinding off one side to the axis of the wire. This leaves sharp cutting-edges on both sides of the tapering point. These edges remove the material in chips or shavings, like a plane or turning-tool. It is not essential to give this form to the style. Any form which will remove the material and not simply displace it will answer. The style is set in one end of a block, 12, provided on the opposite end with a cup, 13, (see Fig. 4,) and secured in the cross-piece 14 by the nut 15. The cross-piece 14 is fastened to a ring, 16, into which a back plate, 17, is secured. These parts, except the steel style, are preferably of hard rubber, although they could be made of another material—of brass, for example. A sound-conveying tube, 18, is screwed into the back plate, 17, the end being just behind the cup 13. A diaphragm, 105, of any suitable material, whose edges are clamped between the ring 16 and back plate, 17, is placed behind the cup 13, which is pressed against said diaphragm by the elasticity of cross-piece 14. The cup 13 and block 12 serve to communicate the vibrations from the diaphragm to the recording-style.

The tube 18 forms part of a hollow standard, upon which the recorder is mounted. The lower part, 19, of this standard is hinged in the bracket 20, as clearly shown in Fig. 2, so that it can be rocked to bring the recorder into or put it out of action.

On the tube or standard 19 is a ring-weight, Z, which is retained in position by a set-screw, 127. It therefore can be adjusted up or down, in order to increase or diminish the pressure of the style 11 against the tablet F. The use of this weight is desirable, but not necessary.

The tube 21 communicates with the interior of the hollow standard through the hinge, and does not therefore interfere with its freedom of motion. This tube 21 can be fixed in the bracket or can be allowed to turn, as may be preferred.

The mouth-piece I is shaped to fit the face of the user, and is provided with a notch, 22, to receive the nose. It is attached to the tube 23, which at its lower end fits snugly in the tube 21 and communicates through the series of tubes 23, 21, 19, and 18 with the space inside and back of the cup 13.

In operation the recorder rests by its own weight, assisted by the pressure of weight Z, or by its own weight alone, if preferred, against the recording-tablet F, said weight causing the style to embed itself to the proper extent in the recording material. The sonorous vibrations impressed upon the style are so rapid, as well as so minute, that the record is made as perfectly as if the recorder were held positively, while at the same time the recorder can be moved bodily to conform to the unevenness of the surface of the tablet, and thus keep uniform the depth at which the style operates.

The tablet F consists of a paper or pasteboard foundation, 24, with a coating, 25, of

wax. A composition excellently adapted to the purpose, and according to our experience the best, consists of one part, by weight, of white beeswax and two parts of paraffine. The two bodies are melted together, and if not perfectly free from dirt and grit should be filtered. A filtration through cotton-wool will answer. The coating is or may be about one-twentieth of an inch in thickness, (the paper being one-tenth of an inch, more or less,) and can be made by flowing the melted composition over the paper disk or foundation. The surface is preferably turned off flat on a lathe.

In order to place the tablet in the machine, the recorder H is turned back out of the way. When the tablet has been secured in place, the recorder is turned forward into the position shown, the style resting against and slightly penetrating the wax coating. A penetration of one one-hundredth of an inch has been found very effective, the style being formed of No. 16 wire-shaped at the cutting end as in Figs. 5 and 6. Upon turning the fly-wheel 8 the disk E and tablet F will be turned, and the style 11 will cut or engrave a spiral line in the wax coating of the tablet. If one talks into the mouth-piece I, the style will be thrown into vibrations corresponding to the spoken words, and the engraved line will be of varying character, the inequalities or variations from uniformity representing the forms of the sound-waves.

The reproducer K, (shown in Figs. 7 and 8,) for reproducing from the engraved tablet, or from an other suitable record the sounds which formed said records, has a reproducing-style, 26, formed of a narrow metal strip bent near the end, as shown in Fig. 8, and pointed, as shown in Fig. 7. This style is held by cementing, riveting, or otherwise, between the strip 27 and the circular plate 28, both preferably of hard rubber. The strip 27 is fastened at the bottom to an offset on the block 29, in which a passage is formed for the sound-waves. This passage terminates just behind the plate 28. There is a fixed disk, 30, of the same size as the movable plate 28. It is cemented or otherwise fastented on the face of the block, and is perforated at the center, in order not to obstruct the opening therein. The plate 28 is close to but not in contact with the disk. The tube 31, fixed at the upper end to the block 29, is joined at the lower end to the tube 33 by a section of soft flexible vulcanized-rubber tubing, 32. For use the tube 33 is slipped into the tube 19 in the manner shown for the tube 18 of the recorder.

The reproducer K when so placed is mounted upon a hollow standard composed of the tubes or tubing 31, 32, 33, and 19, and in consequence of the flexibility of the rubber tubing 32 it is free to follow the record. No special care is necessary to insure its adjustment, for if the reproducer K be allowed to rest against the record with the style upon the engraved line the style will of itself gravitate to the bottom of the groove.

There exists always a liability to disarrangement in some part of the machine either in the recorder or the support therefor or the recording-tablet or its support, or if there be no disarrangement it would be difficult to insure that the reproducing-style should touch the record precisely at the proper point if the reproducer be held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the record. It will be seen that the reproducer is mounted on a universal joint, so that it can move in any direction. The movement parallel with the face of the tablet would, however, by itself allow the style to follow and adjust itself to the record to a useful extent.

In operation the reproducer K is placed against the record, and on turning the wheel 8 in the same direction and at about the same speed that it was turned in recording, the record will move the style 26 and plate 28, so as to throw the air in the hollow standard into vibrations, and produce sound-waves similar to those which originally acted upon the recording-style to make the record. The reproduced sounds are audible by placing the ear in proximity to the mouth-piece I; but it is preferred to withdraw said mouth-piece, and to connect the flexible tube 34 (see Fig. 11) with the tube 21 and listen at the ear-piece 35. After the record has been cut it will of course be understood that the machine is turned back to the starting-point for reproducing. The surface of the cut record can be rendered more smooth by removing the engraved tablet from the machine and exposing the surface to heat—as, for example, by rotating the tablet-face downward over an alcohol-lamp until the surface begins to glisten. Of course a too long exposure would destroy the record. It is the merest surface action that is required. The record can be used for reproducing without submitting it to this operation and without removing it from the machine. It may, however, be removed, and at any time thereafter replaced on the same or a similar machine, and be made to reproduce the original sounds.

The reproducer K′ (shown in Figs. 9 and 10) has the style 26 attached to the outer of two light plates, 36 and 37, which are attached to a diaphragm, 38, of thin sheet rubber clamped at the edges between the ring 39 and the border of the back plate, 40. The tube 31 is fastened in the back plate.

It will be observed that in both forms of reproducer the style 26 projects beyond the edge or end of the instrument, so that the position of its point on the record can be easily seen.

Referring now to Figs. 12 to 17, A is the bed, B an upright frame, D an arbor, E a metal disk, F the tablet, and G a friction-pinion, as in Figs. 1 to 11. The nut 2 and washer 3, the shaft 7, wheel 8, and crank 9, and the paper disk 24 and wax coating 25 are identical with the parts similarly numbered in Figs. 1,

2 and 3. The arbor D, instead of being journaled in a slide, is carried by an arm, L, which is supported by and is fixed on the short shaft 50. This shaft is supported on centers 51 and 52, so that the arm L can be rocked. The worm-wheel 53, loosely mounted on the shaft 50, is held stationary by the clamp M, the jaws 54 fitting on either side of the wheel, and being pressed against it by the thumb-screw 55. The arbor D carries a screw-wheel, 56, which engages the worm-pinion 57 at the upper end of shaft 58. The screw 59 at the lower end of the shaft engages the worm-wheel 53. This shaft 58 and the gears 57 and 59 carried thereby prevent the arm L being turned independently of the worm-wheel 53, except as the said shaft is rotated. As the arbor D, disk E, and tablet F are rotated, the screw 56 turns the shaft 58, and consequently—the worm-wheel 53 being held stationary by the clamp M—the arm L is swung gradually to one side, so that the recorder engraves a spiral line on the wax face of the tablet. When the record has been cut, it is only necessary, in order to restore the tablet to the starting-point for reproducing, to draw back the recorder and to loosen clamp M, when arm L can be moved at once to the proper position.

A recorder constructed and mounted precisely as in Figs. 1, 2, 3, and 4 could be used in this machine; but, as shown, the recording-instrument H' is modified to some extent. The cutting-style 11 (which is the same as that of Figs. 4 to 6) is set into a block, 60, carried by a metal strip, 61. This is fastened to a block, 62, at the lower end of a back piece, 63, which is attached to the upper end of the tube 64, which forms the hollow standard for the recorder, and which is mounted on the bracket 65, so as to be capable of being turned to put the record into or out of action. The sound-conveying tube 66 corresponding to tube 21 of Figs. 1 and 2 communicates through the hinge with the interior of the tube 64. In front of the opening at the upper end of tube 64 is stretched a diaphragm, 67, of thin sheet metal, or it may be of other membrane or material, its edges being clamped between the ring 68 and back piece, 63, soft-rubber rings 69 and 70 being interposed one on each side of the diaphragm. On the opposite side of the diaphragm 67 from the tube 64 a light plate, 71, of metal cupped in the center, is held against the diaphragm by the pressure of the strip 61, a projection on the back of said strip bearing against the said plate 71.

In this machine the reproducer K, instead of being mounted on the same bracket as the recorder when the latter has been removed, is carried by a separate bracket, 72, the tube 73 being hinged thereto, so that the recorder and reproducer remain, or may remain, always attached to the machine, it only being necessary to turn one or the other into position, as may be required.

Referring to Figs. 18 to 20, A is the base or bed, B an upright frame, 7 the driving-shaft, 8 the fly-wheel, 9 the operating-crank handle, and G the friction-pinion, as in Figs. 1 and 2. The arbor P is supported in an upright position in bearings of the frame A B, and is revolved by the friction-pinion G engaging the friction-disk Q. The record is made on a wax-coated strip, R, of paper, which is passed around the periphery of the disk S in the groove formed thereon. As the strip passes in front of the recorder or reproducer, it is wound off one reel—say the reel T—and upon the other reel, U. The strip can be wound back upon the reel T when desired. Each reel rests by its own weight upon a platform or flange, 75, at the upper end of a hollow shaft, 76, which turns upon a stud, 77, fastened at the base to the bed B. A pin, 78, passes through the center of the reel, and forms a journal for it to turn upon. A nut, 79, holds the reel on, and may be used to bind it with more or less tension. On each shaft 76 is a belt-pulley, 80 and 81, respectively, driven by a crossed belt, 82 or 83, from a pulley, 84 and 85, on the arbor P. These pulleys 84 and 85 are loose upon the arbor, but are provided each with a clutch, 86 and 87, so placed (see Fig. 18) that when the arbor is turned to the left the clutch 87 engages the hub 89 on the arbor, and the pulley 85 is turned therewith, while when turned to the right the clutch 86 engages the hub 88. Each shaft 76 has a stop-clutch, 90 and 91, respectively, which holds it stationary when the strip is being wound on the other reel. Thus, when the arbor P is turned to the left the reel U is revolved in the direction indicated by the arrow, and the sleeve-supporting reel T is held stationary. The strip is thus stretched at all times, the degree of tension depending upon the friction between the reels and their supporting-flanges 75. The recorder H" is carried by a cross-piece, 92, supported by posts 93. The style 11 is carried by a cross-piece, 94, to which it is attached by means of the cup 95, of hard rubber, which forms a nut on the screw-threaded shank of the style, and said cup rests against a mica diaphragm, 96, whose edges are clamped between the screw-ring 97 and the back plate, 98. The tube 18, screwed into the back plate, is fastened by soldering or otherwise to the cross-piece 92. The tube 23 of the mouth-piece I fits into said tube 18. The ends of the cross-piece 92 are slotted to fit around the screws at the top of posts 93 and rest upon nuts 99, and are clamped by nuts 100. By means of these nuts the vertical position of the recorder can be adjusted. After one line has been engraved on the strip, the recorder can be adjusted to engrave as many additional lines parallel thereto as the strip will receive. The slots in the cross-piece 92 allow the recorder to be moved toward and away from the strip, so as to regulate the depth of the engraved line. To insure a greater nicety of adjustment, screws 101 are

tapped through the metal at the closed end of the slots, and bear at the point against the supporting-screws.

The reproducer K', Fig. 20, is similar to that shown in Figs. 9 and 10, except that the style 26 is so placed that the point is at the center instead of projecting beyond the edge of the instrument. Its position on the record is therefore not so readily seen; but with the form of machine shown in these figures this is less important. The same may be said of the loose mounting of the reproducer, although in point of fact the thin rubber diaphragm 38 gives a certain lateral play to the style. The tube 31 is rigidly fastened to a cross-piece, 102, identical with the cross-piece 92, and with said tube 31 the bearing-tube 30 and ear-piece 35 are connected.

The paper strip can be easily coated with the beeswax and paraffine compound by running the same through a body of melted composition and scraping one side, leaving what adheres to the other to harden thereon.

In Fig. 21 an arrangement for operating the recorder by electro-magnetism is shown. The magnet 107 is mounted on a bar, 108, journaled in bearings in standards 109. It is provided with a bobbin, 106, of wire, surrounding the pole piece, which bobbin is included in a circuit over which electrical undulations are caused to pass by any suitable transmitting-instrument—for example, such as commonly employed on telephone-lines. In front of the pole-piece or core of the bobbin is a diaphragm, 105, of magnetic material, whose edges are clamped between the ring 16 and back plate, 17. The cup 13 should always be in contact with diaphragm 105, and is pressed against it by the spring of piece 14. This cup, as well as the style 11, block 12, nut 15, and cross-piece 14, is the same as in the recorder H of Figs. 1 and 4.

It is evident that various modifications other than those indicated can be made and the invention still be employed in whole or in part, and also that parts of the invention may be used separately.

In the foregoing description details have been given with some minuteness. This has been done to furnish the best information in our power for enabling those skilled in the art to make and use the invention, and not with the intention of limiting the invention to the precise dimensions, proportions, shapes, and materials stated.

A means has been shown for impressing vibrations upon the recording-style by an electrical current through the intermediary of an electro-magnet, in a manner similar to that in which the diaphragm of an ordinary receiving-telephone has been vibrated.

It is evident that other means heretofore used for vibrating a diaphragm could be used in place of the magnet; also, it is evident that the vibrations of the reproducing-style could be taken up and transmitted by the means heretofore used for taking up and transmitting vibrations, (those of a telephone-diaphragm, for example.)

The term "cutting" is herein employed to indicate an action in which the material is removed in chips, shavings, or other small pieces—as in engraving, turning, and the like—and not simply displaced.

The displacement of the material is not only a different operation from the cutting contemplated by this invention, but is not calculated to accomplish the objects for which cutting or graving is employed.

Having now fully described our said invention and the manner in which the same is or may be carried into effect, what we claim is—

1. The method of forming a record of sounds by impressing sonorous vibrations upon a style, and thereby cutting in a solid body the record corresponding in form to the sound-waves, in contradistinction to the formation of sound-records by indenting a foil with a vibratory style, or cutting a strip by vibrating it against a revolving disk-cutter, substantially as described.

2. The method of forming a sound-record by impressing the sonorous vibrations upon a style in a direction at right angles to the recording-surface, and thereby cutting in a solid body a series of elevations and depressions of varying depth, corresponding in form to the sound-waves, substantially as described.

3. The vibratory cutting-style of a sound-recorder, substantially as described.

4. The cutting-style, in combination with a support permitting the same to be vibrated, and means for impressing sonorous vibrations thereon, substantially as described.

5. A vibratory cutting style, in combination with a sound-conveying tube for concentrating the sound-waves upon the style, substantially as described.

6. A vibratory cutting style, in combination with a tablet or other solid body in which the record is to be cut, and mechanism for supporting the same and moving it with reference to the said style, substantially as described.

7. A sound-record consisting of a tablet or other solid body having its surface cut or engraved with narrow lines of irregular or varied form corresponding to sound waves, substantially as described.

8. A sound-record consisting of a tablet or solid body having its surface cut or engraved with a number of lines of variable cross-section, the irregularities or variations corresponding in form to sound-waves, substantially as described.

9. The method of forming a sound or speech record which consists in engraving or cutting the same in wax or a wax-like composition, substantially as described.

10. The sound or speech record cut or engraved in wax or a wax-like composition, substantially as described.

11. The recording-tablet of a phonograph or sound-recording machine, having as the material for recording sounds or sonorous vibra-

tions the composition of beeswax and paraffine, substantially as described.

12. The sound or speech record cut or engraved in a wax like composition, such as the compound of beeswax and paraffine, substantially as described.

13. A tablet or body for recording sound-vibrations, consisting of a paper or pasteboard foundation and a surface coating of beeswax and paraffine compound, substantially as described.

14. The sound or speech record cut or engraved in a wax-like composition, such as the described compound of beeswax and paraffine, constituting a surface-coating to a paper or pasteboard foundation, substantially as described.

15. The method of making a sound or speech record which consists in engraving or cutting in the recording material an irregular groove with sloping walls, the shape of the groove representing the sound-vibrations, substantially as described.

16. The method of making a sound or speech record which consists in cutting in the recording material a groove with sloping walls and of variable cross-section, the variations corresponding in form to sound-waves, substantially as described.

17. The sound-record in the form of an irregular groove with sloping walls cut in solid material, substantially as described.

18. The sound-record cut in wax or wax-like composition in the form of an irregular groove with sloping walls, substantially as described.

19. The combination, with a reproducing-style, of a mounting therefor, which leaves said style-face to move laterally, and thereby adjust itself automatically to a sound-record, substantially as described.

20. The reproducer loosely mounted on a suitable support, so that the reproducing-style is capable of a lateral movement, and may in consequence thereof adjust itself automatically on the record, substantially as described.

21. The reproducer mounted on a universal joint and held against the record by yielding pressure, substantially as described.

22. The combination, with a grooved tablet or other body having a sound-record formed therein, of a reproducer having a rubbing-style loosely mounted, so that it is free to move laterally, and thus adjust itself to the groove, substantially as described.

23. The combination, with the tablet or other body having the sound record formed therein as an irregular groove with sloping walls, of a reproducer having a style for rubbing over said record and mounted on a universal joint, substantially as described.

24. The combination, with a sound-record formed in wax or a wax-like material, of a reproducer having a rubbing style for receiving sonorous vibrations from said record, substantially as described.

25. A reproducer having a style projecting beyond the edge or end of the instrument, so that the position of the point of the style on the record may readily be seen, substantially as described.

26. In a reproducer, the combination, with a vibratory plate or diaphragm, of a reproducing-style fastened flatwise on said plate or diaphragm and bent at the end, substantially as described.

27. The method of recording and reproducing sounds by cutting the record in a wax or wax-like material, and then rubbing over the record the style of a suitable reproducing instrument, so as to impress sonorous vibrations on said style, substantially as described.

28. The method of improving a sound-record which consists in producing an incipient fusion of the surface, substantially as described.

29. The improvement in preparing a sound-record, consisting in cutting the record in a fusible material, and then producing an incipient fusion of the surface, substantially as described.

30. The sound-recorder having a vibratory cutting-style held against the recording material by yielding pressure, substantially as described.

31. The recording-instrument having a vibratory cutting-style and mounted on a hinged arm, substantially as described.

32. The combination, with the tablet or body in which the sound-record is to be made, of the recording-instrument mounted on a hinged arm and resting by gravity against the tablet, substantially as described.

33. The recorder mounted on a hollow arm or standard, which constitutes also a sound-conveyer, substantially as described.

34. The recorder mounted upon an arm or standard hinged to its bracket or base, and provided with a sound-conveyer extending lengthwise of said arm, substantially as described.

35. The recorder mounted upon a hinged arm, and combined with a sound-conveyer which extends lengthwise of the arm, and is connected at the hinge with an exterior sound-conveyer, substantially as described.

36. The reproducer mounted upon a hollow standard which forms a sound-conveyer, substantially as described.

37. The reproducer mounted on a hinged arm, and provided with a sound-conveyer extending lengthwise of said arm, substantially as described.

38. The reproducer mounted on a hinged arm, and provided with a sound-conveyer extending lengthwise of said arm, and connected at the hinge with an exterior sound-conveyer, substantially as described.

39. The combination, with a sound-recorder, of a mouth-piece shaped to surround the mouth and nose of the user, and to concentrate the sound upon the recording devices, substantially as described.

40. The combination, with the tablet, in the form of a disk, and a recorder or reproducer,

of mechanism for causing a spiral line to be traced on the disk by the recorder or reproducer at a uniform surface-speed, substantially as described.

41. The combination, with the tablet, in the form of a disk, the arbor, and the metal disk operating as a friction-wheel, of the slide, or its equivalent, such as herein shown, in which said arbor is journaled, and the friction-pinion for revolving said disk, substantially as described.

42. The combination, with the recorder or the reproducer, the disk, the arbor, and the laterally-movable support to the arbor, of the friction-pinion placed behind and bearing against the disk at a point opposite the recorder or reproducer, substantially as described.

43. The combination, with a recording-style and the support therefor, of a cap on the back of said support, and the sound-conveying tube terminating just behind the cap, substantially as described.

44. In combination with the style of a sound-reproducer, a vibratory body or plate of hard rubber, upon which vibrations are impressed by said style, and through which they are transmitted, substantially as described.

45. A tablet provided with a wax or wax-like coating, and having engraved in said coating a spiral line with inequalities or irregularities corresponding in form to sound-waves, substantially as described.

46. A tablet provided with a coating of wax or wax-like composition, and having a sound-record engraved in said coating, said engraved coating having the glazed surface which results from an incipient fusion of the wax after cutting or engraving the record, substantially as described.

47. In combination with a sound-recorder, a flaring mouth-piece shaped to fit over the face of the user and to include his nose, and communicating through a tube or contracted opening with the space behind the diaphragm of said recorder, substantially as described.

In testimony whereof we have signed this specification in presence of two subscribing witnesses.

CHICHESTER A. BELL.
SUMNER TAINTER.

Witnesses:
PHILIP MAURO,
C. J. HEDRICK.

399
(No Model.)

5 Sheets—Sheet 1.

S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288. Patented May 4, 1886.

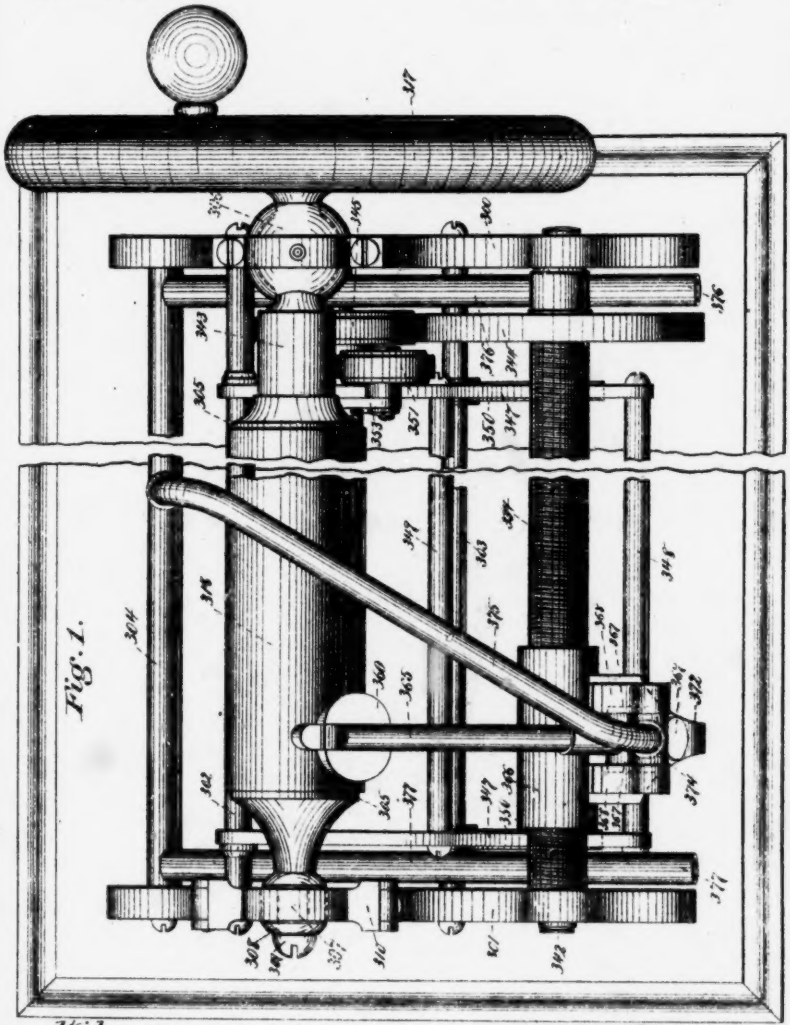

Fig. 1.

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400

(No Model.) 5 Sheets—Sheet 2.

S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288. Patented May 4, 1886.

Fig. 17.

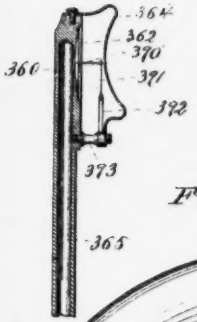


Fig. 8.

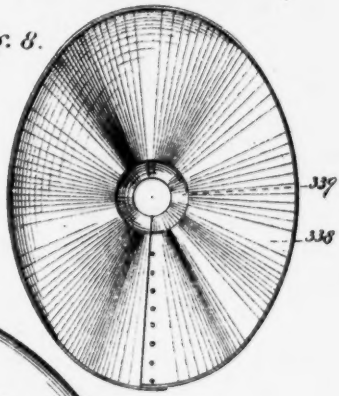
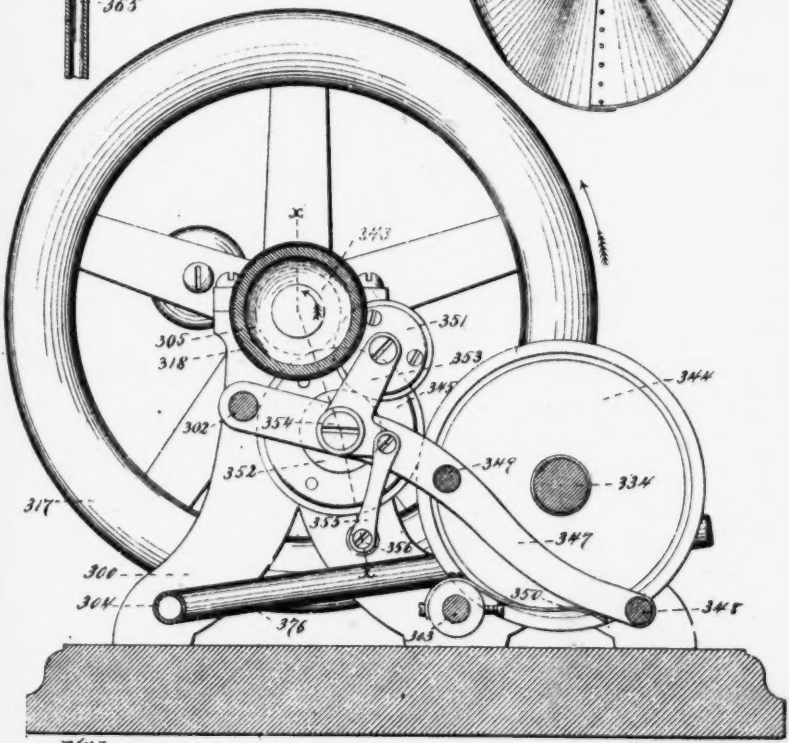


Fig. 2.



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(No Model.)

5 Sheets—Sheet 3.

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APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288. Patented May 4, 1886.

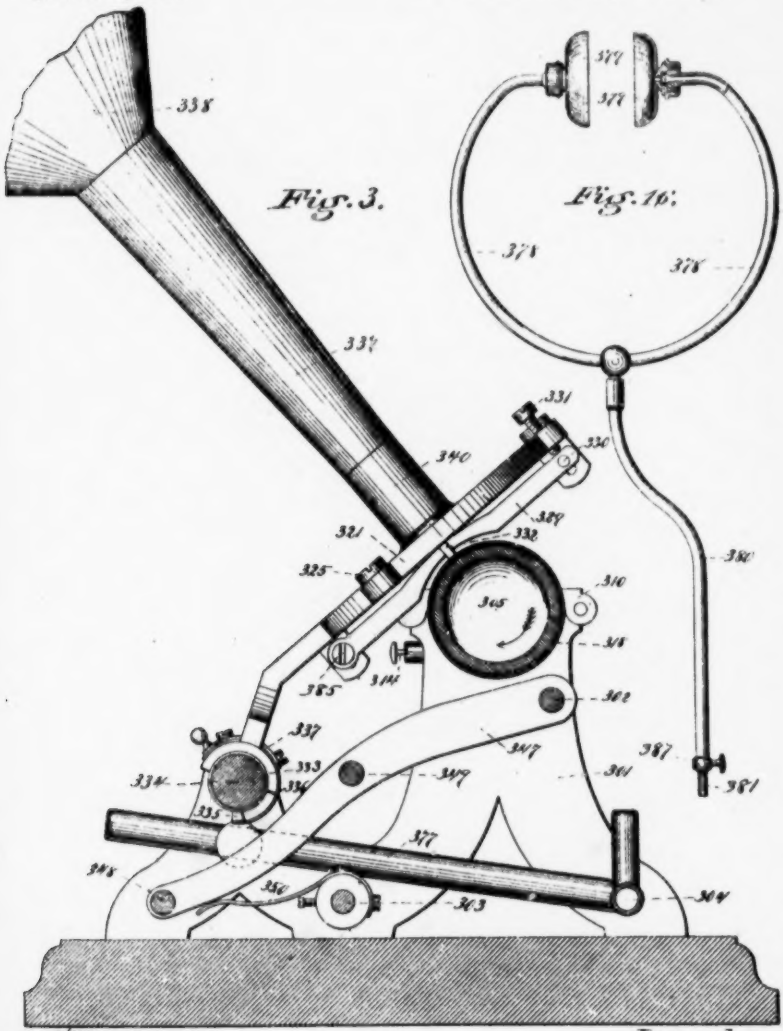

Fig. 3.

Fig. 16.

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402
(No Model.)

5 Sheets—Sheet 4.

S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288. Patented May 4, 1886.

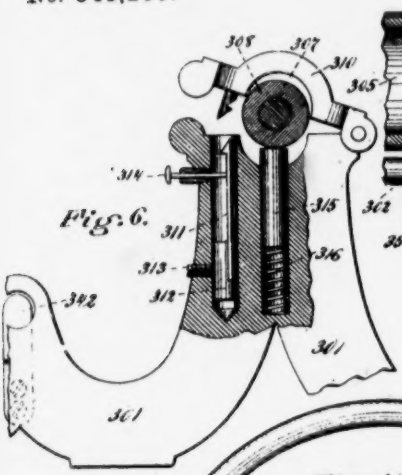


Fig. 6.

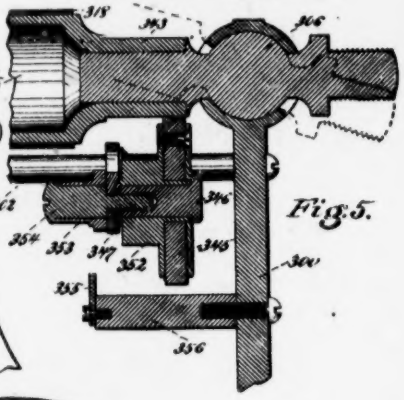
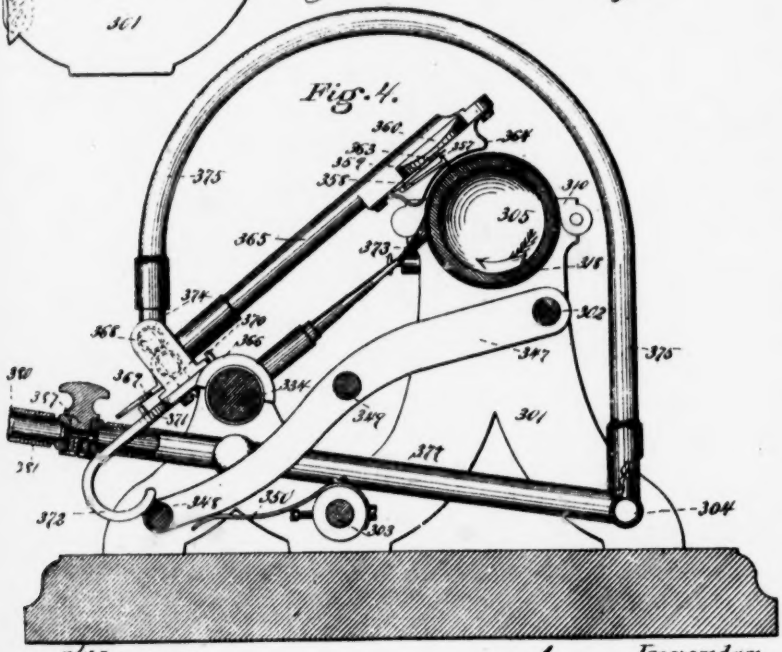


Fig. 5.

Fig. 4.



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Philip Mauro

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Sumner Tainter by
A. Pollok
his attorney.

403
(No Model.)

5 Sheets—Sheet 5.

S. TAINTER.

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Fig. 7.

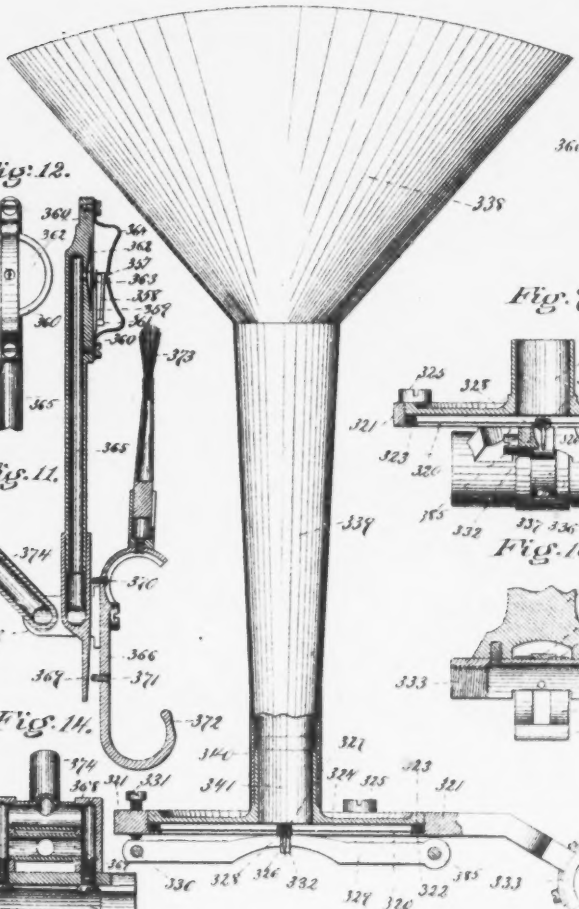


Fig. 15.

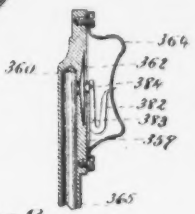


Fig. 12.

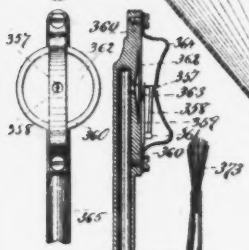


Fig. 11.

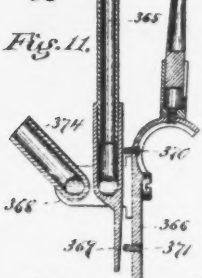


Fig. 14.

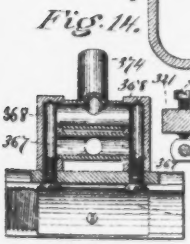


Fig. 9.

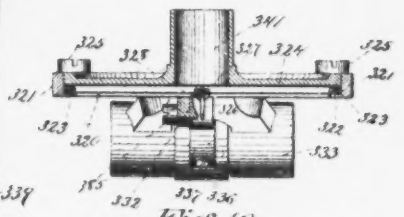
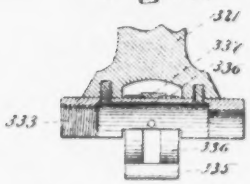


Fig. 10.



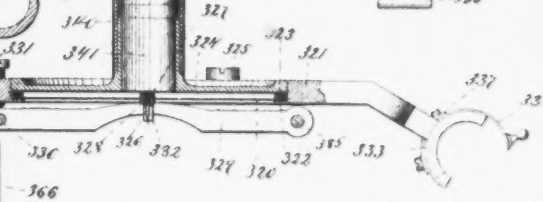
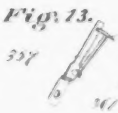


Fig. 13.



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his Attorney

UNITED STATES PATENT OFFICE.

SUMNER TAINTER, OF WASHINGTON DISTRICT OF COLUMBIA.

APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

SPECIFICATION forming part of Letters Patent No. 341,936, dated May 4, 1886.

Application filed December 4, 1885. Serial No. 184,855. (No model.)

To all whom it may concern:

Be it known that I, SUMNER TAINTER, a resident of Washington, in the District of Columbia, have invented a new and useful Improvement in Apparatus for Recording and Reproducing Sounds or Sonorous Vibrations, which improvement is fully set forth in the following specification.

This invention has for its object to increase the general efficiency of apparatus for recording and reproducing speech and other sounds, commonly known as "phonographs;" and it consists, principally, in the following improvements:

First. A new recording-tablet is employed. It consists of a hollow cylinder or tube of paper, or other suitable material, coated with wax or wax-like composition, preferably a compound or mixture of beeswax and paraffine. The record is cut in the coating. The advantages of this form of tablet are that it may be very light while having sufficient stiffness to retain its form and avoid the danger of cracking the coating, that it is compact and adapted for transmission through the mails or otherwise, that the recording-surface is continuous, and that it can very readily be placed on and removed from the holder by which it is supported and rotated in recording and reproducing.

Second. The tablet-holder is made in the form of a cylinder, over which the tubular tablet can be forced or slipped and from which it can be removed as desired. This cylinder may be solid; but for lightness it is preferably made hollow. It is of metal, or may be of other solid material. It is journaled in bearings, and is provided with a crank or other means for rotating the same.

Third. In order to support the tablet-holder in the most solid manner, it is provided with a journal at each end, and the journals and bearings are constructed to prevent end motion. It is made detachable from its support at one or both ends, in order to permit the placing and removal of the tablet. It will be understood that any ordinary or suitable means may be used for this purpose; but it is preferred to use the means next to be described.

Fourth. To facilitate the placing of the tablet on the holder and its removal therefrom, and to avoid the removal of the tablet-holder from the machine-frame when this operation is performed, a ball-journal fitting in a cup or socket bearing is employed at one end, (the other end being made detachable from the machine-frame,) so that the holder can readily be tipped up and held in that position while placing or removing the tablet. The ball-journal and socket-bearing prevent end motion of the tablet-holder.

Fifth. With the object of further facilitating the placing and removal of the tablet, the detachable end of the tablet-holder is held down by means of a catch or other device which can readily be released, and a spring is combined with the holder in such a way as to raise the detachable end thereof when the catch is released.

Sixth. The journal at the detachable end of the tablet-holder, instead of resting directly upon the machine-frame, or a bearing attached thereto, is provided with a box or sleeve which fits over the journal and forms the bearing therefor. This box or sleeve remains on the journal when it is detached, and protects it from dirt, as well as prevents the lubricant on the journal from soiling the hands of the person using the machine. The spring for raising the holder acts upon this box, (a rod being interposed,) and the journal is relieved of its pressure. Another advantage which the use of this box or sleeve gives is that if the two bearings in the machine-frame are not precisely in line the box or sleeve may adjust itself properly without jamming the journal. The very slight space which always intervenes when two separate pieces rest in contact will suffice to compensate for the very slight irregularity in alignment which a careful workman would leave.

Seventh. For recording the sonorous vibrations in or on the tablet, and for producing the sounds from the record, the recording or the reproducing instrument (called hereinafter "recorder" and "reproducer," respectively,) is moved lengthwise of the tablet by a screw, which is revolved at a less speed than the tablet. Thus with a comparatively coarse-threaded screw the lines may be traced on the tablet very close together. Heretofore the lines were the same distance apart as the threads of the screw.

Eighth. To enable the recorder and reproducer readily to be applied to and removed from the screw, so that one screw can be used for both instruments, they are each provided with a divided or partial nut, which engages the screw. To prevent the instrument from being disengaged accidentally, a guard is or may be provided which can be slipped under the screw when the instrument is in place, or be withdrawn when it is desired to remove it. Both the reproducer and the recorder may have such a guard; but practically it is more important for the recorder.

Ninth. Instead of having the recorder and reproducer mounted upon a slide moving in ways or guides, and connected with a screw for moving the same, they are mounted on a carrier, which is not only engaged by said screw, but supported by the same, so as to be movable lengthwise of the screw, and capable also of turning on it as on a journal. Thus devices heretofore considered necessary are dispensed with and a movement of the recorder or reproducer toward and away from the tablet is provided for.

Tenth. It is often desirable, especially in reproducing, to stop the operation of the machine temporarily. To enable this to be effected instantly without stopping the main shaft of the machine, mechanism is provided for putting the feed-screw out of action, and at the same time automatically lifting the instrument clear of the record. Heretofore it has been necessary to stop the machine entirely. This is not desirable, because in stopping and restarting the machine a difference in speed, which appears on the record or in the sounds reproduced, is almost certainly made, particularly where a fly-wheel is used to give steadiness of motion.

Eleventh. It is also desirable in reproducing to be able to repeat a word, a sentence, or paragraph. To effect this a reversing as well as a stop mechanism is employed, so that by bringing said mechanism into action the motion of the reproducer is reversed and the instrument is brought back to the beginning of the part to be repeated, being meanwhile lifted clear of the record, which continues or may continue to revolve in the same direction at a uniform speed

Twelfth. In order that the depth of the record may be unaffected by the slight distortions of the recording-surface, (which it is very difficult to avoid, whether this surface be plane, as in the disk-tablet, or cylindrical, as in the improved form of tablet before indicated,) the recorder is pressed toward the recording-tablet by yielding pressure, (such as that of gravity or a spring,) and is provided with a rest, which bears upon the tablet. The recording-style projects beyond this rest and is connected with a diaphragm or other known or suitable means for impressing sonorous vibrations upon it independently of the rest. By having the recorder maintained always at a given distance from the recording-surface independently of the recording-style, it is possible to cut effectively a shallower record than can be done otherwise, because if the recorder is held stationary the depth of the record must always be greater than the variations in the distance of the recording-surface due to the distortions thereof, and, on the other hand, if the yielding pressure of the recorder is borne by the style it will, if heavy enough for other purposes, press the style to a greater depth than is otherwise necessary. The use of the rest thus relieves the recording-style of pressure, and enables it to be mounted more sensitively and to be made lighter, while at the same time and for a like reason its amplitude of vibration under a given impulse and consequently the strength of the record are increased. The rest could course, be used with any ordinary or suitable mode of mounting the style.

Thirteenth. To regulate the depth of the record the rest is made adjustable lengthwise of the recording-style.

Fourteenth. In order to secure the most sensitive mounting for the recording-style, the latter is made from a short piece of wire and is attached directly to a diaphragm, so as to be carried thereby, the means preferably employed being a screw-thread on the style, a nut of hard rubber engaging the same, and a disk or washer of hard rubber, between which and the nut the diaphragm is clamped.

Fifteenth. A sound conveyor or concentrator is used for the recorder, which concentrator comprises a flaring mouth-piece of elliptical or oval section and a tapering tube forming a continuation thereof. It is found that a mouth-piece which concentrates the sound is desirable to increase the strength of the record, that a mouth-piece which covers the nose is desirable to convey the nasal as well as other vibrations, and that a tapering tube is desirable to amplify and re-enforce the sound-waves. It is found that the longer this tube is, within certain limits, the greater its re-enforcement of the sound; but that a too great length gives a hollow effect, as when words are spoken into an empty barrel. For the sake of lightness it is preferred to make the mouth-piece and tube of thin sheets of hard rubber, or of paper, or the like material. Metal mouth-pieces and tubes have also been used with good effect.

Sixteenth. Where the record is cut in wax the little shavings or chips are apt to cling to the record and have to be brushed off before reproducing. This can be done by hand; but it is not desirable to rely wholly upon hand-brushing, as too much care would have to be exercised to insure that no particles adhere. The record is also liable to collect dust. To avoid difficulty on these accounts without care on the part of the user, the reproducer is provided with a small brush, which bears upon the tablet and sweeps the record in advance of the reproducing-style.

Seventeenth. The record is not always per-

fectly true or straight—that is to say, the recording-style not only moves lengthwise or at right angles to the recording-surface, but has or is liable to have a side vibration, which of course is recorded in the tablet. These side vibrations produce errors in reproducing unless means are provided for enabling the reproducing-style to move sidewise also. The mounting of the reproducer on a universal joint obviates the difficulty to a certain extent, but not altogether satisfactorily, since the inertia due to the large mass of the reproducer is too great for it to respond as quickly as required. The difficulty is in the present invention overcome much more thoroughly by supporting the reproducing-style so that it, or at least the end in contact with the record, can move sidewise independently of the diaphragm or other device upon which it impresses the vibrations. This freedom to move sidewise can be secured by allowing the style to rock upon the end in contact with the diaphragm or other device behind, or by making the style in whole or in part of flexible material, or by mounting it on a flexible support, the flexibility of course being in the required direction.

Eighteenth. In order to allow the reproducing-style the greatest freedom of side movement, while insuring its return to a central position, and without impairing to a serious extent its rigidity in other directions, a comparatively broad and thin strip of spring metal, placed on edge is connected with or forms part of the reproducing-style. Such a strip is very flexible to side pressures, but comparatively rigid to other pressures. The strip is fastened to the diaphragm, or to the device upon which it is desired to impress the vibrations, or it is otherwise hinged so that it can impress vibrations on said device; or said strip may be rigidly connected with the frame of the reproducer and the style be flexibly connected with the outer end of the strip. Preferably the reproducing-style is fastened to the end of a thin metal strip parallel with the width thereof, so as to form a hammer-like arrangement, the style being the hammer-head. It is a pin or wire several times as thick as the metal strip. The vibrations are transmitted through the hammer-head, the metal strip being attached to a spring, or it may be otherwise hinged to the frame of the reproducer.

Nineteenth. In transmitting the vibrations to the diaphragm it is found that with a rigid connection between the record and the diaphragm pronounced foreign vibrations are impressed upon the diaphragm or its substitute, producing scratching noises. These foreign noises can be lessened without diminishing the reproduced speech to the same extent by the interposition of a flat metal spring in such a way that while serving as the means of communicating vibrations to the diaphragm it can be bent independently. It is probable that this spring absorbs the vibrations which produce the scratching noises to the greatest extent, because they are more minute and rapid than speech-vibrations. Heretofore a section of rubber tubing has been interposed between the style and diaphragm; but it cannot be made as delicate as a metal spring, and for other reasons, also, is not so advantageous. For example, it is believed that it does not transmit the true vibrations of the record with as much clearness, the rubber loses its elasticity after a short time, and the tubular form of spring is less compact and less easily secured in place.

Twentieth. Another difficulty in reproducing is the passage of the style from one elevation of the record to the next without descending to the bottom of the space between. This causes a rattling sound, and sometimes makes the reproduction unintelligible. It is overcome to a useful extent, if not entirely, by combining with the style a quick-returning spring, by which the style will be pressed to the bottom of the record in the short space between two elevations. This spring should be of quicker return than the diaphragm. It is evident that the same spring may perform this function and also that of absorbing the foreign vibrations.

Twenty-first. The diaphragm is pressed against a concave seat whose walls converge like the walls of a cone, or of a section of a sphere, ellipsoid, paraboloid, or the like toward an opening through which the sound can escape. Thus a space of the general shape of a plano-convex lens, or, taking into consideration the slight convexity of the inner side of the diaphragm of a concavo-convex lens, is formed behind the diaphragm. This form of space is found to convey the sounds better than the flat space, such as customary in speaking-telephone receivers as well as in the ordinary phonograph. This concave seat for the diaphragm is also advantageous, as it makes the latter self-centering. A spring bearing upon the diaphragm holds it in place and also strains it. This spring may or may not be employed for absorbing the foreign vibrations, or for giving a quick return to the style, or for both. The arrangement preferably employed is to have a light flat spring project above the diaphragm, a block (say of cork) being interposed between the spring and the diaphragm and the style pressing against the end of the spring a short distance beyond the block. The block may be secured in the most effective position or it may be left unfastened, so that it can be adjusted lengthwise of the spring to increase or diminish the part projecting beyond the block or to bring it directly under the style. In this last position the loudest reproduction is obtained, but the scratching and rattling noises are also the most pronounced.

Twenty-second. The diaphragm is preferably made of hard rubber, this material having been found to give out pure sounds, the minute foreign vibrations being absorbed to a

greater extent than with mica or metal, either of which and other materials also can be used with intelligible results.

Twenty-third. To protect the style from accidental injury, it is protected by a guard, beyond which only the rubbing end or point of the style projects. As a further protection, the guard is curved outward on either side of the style, forming horns, which, if the reproducer be placed face down on a table, sustain the weight instead of allowing it to come on the style. The particular form of guard is of course only suitable for use with a cylindrical record, which can enter between the horns to make contact with the style.

Twenty-fourth. The sounds from the reproducer can be conveyed to the ear in various ways; but preferably the space behind the diaphragm or other vibratory body is connected by a sound-conveying tube with a double ear-piece somewhat similar to a stethoscope. It consist of two elastic and flexible hollow branches provided each with a cup fastened to the branch by a ball-and-socket joint. The cups fit over the ears and are held against the head by the elasticity of the branches, the universal joint allowing each cup to adjust itself to the head of the user.

Twenty-fifth. It is found desirable in reproducing to modify the loudness of the reproduced sounds according to the sensitiveness of the ear of the listener. This effect can be produced by the adjustment of the block between the spring and the diaphragm mentioned above under the twenty-first head; but it is not always convenient or advantageous to produce it in that way—as, for example, if two persons are listening to the instrument at the same time. To accomplish the desired object, a stop-cock is placed in the sound-conveying tube between the reproducer-diaphragm and the ear, so that by partially closing the same more or less of the sounds can be cut off, as desired. Where more than one person is listening, each of the sound-conveyers may have its own stop-cock.

Twenty-sixth. When a device such as just described is used, or when any device is used which is to be held by the user, or to be placed close to his ear, there is always a liability of the user pulling upon or jarring the reproducer, and if this is not firmly secured of pulling it from the machine. To overcome this difficulty without interfering with the traverse of the reproducer in front of the record, a flexible connection adapted to convey sound, and at the same time not restrict the traverse of the reproducer, is provided between the reproducer and a tube or tubular coupling attached to the machine-frame. The ear-tube or other device is connected with this tube or coupling, so that any pull or thrust comes upon the solid machine-frame, and will or may detach the ear-tube rather than damage the machine.

Twenty-seventh. In placing the reproducer on the screw it is desirable to hold the style away from the record until the reproducer is in place on the screw, and in removing it to lift the style from the record before attempting to remove the reproducer. The object is to prevent injury to the record. To effect the desired result the standard of the reproducer is hinged to its base or carrier, and is provided with a tail or thumb piece, or some equivalent device, so that in grasping the base or carrier the thumb or other part of the hand pressing upon said tail will hold the reproducer away from the record. Upon release of the tail the reproducer rests by its weight (which is preferably made very small) upon the record.

The invention further comprises certain special constructions, combinations, and arrangements of parts, as hereinafter set forth, among which are included the combination, in one machine, of the several improvements already indicated, or of two or more of them.

Having explained the principle of the invention, a description will now be given of what is considered the best mode of applying the same, reference being had to the accompanying drawings, which form a part of this specification

Figure 1 is a plan view of a machine or phonograph constructed in accordance with the invention, the reproducer being shown in place and the recorder omitted; Fig. 2, a vertical cross-section in elevation, looking to the right in Fig. 1; Fig. 3, a section in the plane of Fig. 2, but in elevation, looking to the left, the recorder being shown in place and its mouth-piece being broken away; Fig. 4, a view similar to Fig. 3, but with the reproducer in place instead of the recorder; Fig. 5, a partial vertical longitudinal section on line x x of Fig. 2; Fig. 6, an elevation, partly in section, of a part of the left end of the machine. Fig. 7 is an elevation, partly in section, of the recorder, its carrier, and sound-concentrator; Fig. 8, a top view (on a reduced scale) of the sound-concentrator of the recorder; Fig. 9, a central section of the recorder in a plane at right angles to those of Figs. 3 and 7, showing the base or carrier in elevation, and Fig. 10 a section through the base or carrier of the reproducer. Fig. 11 is a central vertical section of the reproducer, its carrier, and certain accessory parts; Fig. 12, a face view of the reproducer; Fig. 13, a perspective detail view; Fig. 14, a section through the base or carrier of the instrument; Fig. 15, a section illustrating a modified form of style; Fig. 16, an elevation, partly in section, (on a reduced scale,) of a listening device with double ear-pieces; and Fig. 17 a section illustrating a third modification of the reproducer.

The frame of the machine, as shown, consists of two upright side pieces, 300 and 301, connected by tie-rods 302 and 303 and the tube 304, which serves as a tie-rod. The tablet-holder 305, in the form of an elongated metal cylinder, is journaled in bearings at the top of the side pieces. The right journal, 306, is ball-

shaped and rests in a socket, (see Fig. 5,) which permits the tablet-holder to be tilted up, as indicated in dotted lines, as well as to be revolved, while endwise motion is effectually prevented. The fly-wheel 317, provided with a crank-handle, is mounted on a prolongation of the journal and serves to revolve the tablet-holder. The left journal, 307, which is or may be cylindrical, fits and revolves within a box, 308, which is held in place on the journal by a screw, 309, in the end thereof. The box 308 is confined between a seat on the side piece, 301, and the hinged cap 310, which is held down by the spring-catch 311, (see Fig. 6,) fastened at the bottom in the plug 312, which is adjustably retained in position by the set-screw 313. The catch can be released at will by a push-pin, 314. Below the journal 307 is a follower, 315, fitting into and movable in a hole in side piece, 301, acted upon by the spiral compression-spring 316, placed below it in the hole. The box 308 rests upon the top of the follower and relieves the journal of all pressure from the spring 316 when the cap 310 is held down by the catch 311. This pressure prevents the box turning. On releasing the catch 311 the spring 316 expands and throws up the journal 307 and the cap 310, as shown in Fig. 6. The cap can then be turned back and the tablet-holder be tipped up and held in an inclined position by a hand on the fly-wheel 317. The tablet consists of an elongated hollow cylinder or tube, 318, of paper or pasteboard—say one-fortieth of an inch in thickness—coated with a layer about one-thirtieth ($\frac{1}{30}$) of an inch in thickness of a compound of one part, by weight, of white beeswax and two parts of paraffine. The beeswax and paraffine should be melted and stirred together, and then filtered, unless they are entirely free from sticks, dirt, and other foreign particles. The coating is or may be applied by stopping the ends of the cylinder, partly immersing it in a bath of the melted composition and turning it therein one or more times, removing it and allowing the material to harden, keeping it in motion meanwhile to prevent running, then immersing and rotating it again, and allowing the adherent layer to harden, and so continuing until a coating of rather more than the thickness above indicated is attained. The surface is then turned smooth in a lathe, being supported on a cylinder like the tablet-holder 305. The tablet is then ready for use by placing over the holder, or it may be kept until wanted. In keeping care should be taken to prevent access of dust. After the tablet has been placed on the holder the detachable end of the latter is pressed down into its bearing, and the cap 310 is engaged by the catch 311, which holds it down.

The record is made on or in the wax coating of the tablet by the instrument shown in Figs. 3 and 7 to 10. The diaphragm 320 (of mica, from six to twelve one-thousandths [illegible] to $\frac{1}{1000}$) of an inch in thickness) is held in a frame, 321, between the flange 322 and a ring, 323, of soft rubber tubing, which is held down by the back plate 324, and screws 325, tapped into the frame. The heads of these screws project over the edge of the back plate. The recording-style 326, formed of a steel wire (say, one-thirty-second of an inch in diameter) sharpened at the front or operating end, like an ordinary round-pointed turning tool and screw threaded at the other, is fastened to the center of the diaphragm by the nut 327 and washer 328, which are on opposite sides of the diaphragm, and clamp it between them. The cutting-edge of the style is preferably shaped to cut a groove of curved rather than of V-shaped cross-section. A bar, 329, is hinged at one end to the frame 321 by a pivot screw-pin, 385, and at the other adjustably but rigidly fastened thereto by a screw, 330. A second screw, 331, bearing at the point against the top of the bar 329, assists in securing an exact adjustment and in holding the bar rigid. At the middle of the bar is an enlargement, 332, which extends into close proximity to the recording-style (see Fig. 9) and whose bottom is polished or made smooth, so that it may bear upon the wax-coated tablet and move over it without injury to the wax surface. The frame 321 is provided with a base or carrier, 333, in the form of a half-nut. In use this nut is supported and engaged by the rotatory feed-screw 334, which is journaled in bearings in the side pieces, 300 and 301. The base or carrier is elongated to give a sufficient bearing on the screw to prevent the tipping of the recorder sidewise. To assist in preventing this, and also to prevent the carrier being lifted from the screw, a guard is provided, which consists of a block, 335, attached to the end of a curved slide, 336. This slide is guided by the piece 337, and can be turned from the position shown in Fig. 7 when the guard does not interfere with the placing of the carrier on the screw into the position shown in Figs. 3 and 10, when it prevents the removal. The carrier is, however, free to turn on the screw, as on an axle, so that the recorder, under the action of gravity, will press against the tablet, the bar 329 forming a rest to support it. The recording-style projects beyond the rest and enters the wax coating, penetrating it a distance which is regulated by the adjustment of said rest or bar 329. The sound-conveyer consists of an elliptical mouth-piece, 338, and a tapering tube, 339, both made, for lightness, of hard rubber, in thin sheets—say one-thirty-second ($\frac{1}{32}$) of an inch thick. A metal thimble, 340, is attached to the small end of the tapering tube, which fits over a tubular projection, 341, on the back plate. The rotation of the feed-screw 334 moves the recorder lengthwise of the recording-tablet, and this movement, in connection with the rotation of the tablet, causes the style to trace a spiral line in the wax, which line becomes a sound-record by talking into the mouth-piece 338, and thereby impressing sonorous vibra-

tions upon the diaphragm and style. The style then cuts a variable line, whose irregularities or inequalities correspond to the sound to be recorded. The spiral line can be omitted for a given distance, when desired, by simply lifting the recorder from the tablet. The feed-screw 334 should be so mounted as to prevent endwise movement, which would tend to make the traced line more or less zigzag. As shown, a spring, 342, (see Figs. 1 and 6,) presses constantly upon the left end of the screw to keep it against the bearing at the opposite end. The feed-screw is revolved by the friction-wheels. (Shown in Figs. 1, 2, and 5.) In recording, the friction-pinion 343 on the tablet-holder communicates motion to the large wheel 344, fast on the feed-screw, through the intermediate 345. Thus the feed-screw has a much slower rotation than the tablet-holder, and the convolutions of the line traced on the tablet are much closer together than the threads of the feed-screw. The intermediate 345 is mounted on the stud 346, (see Fig. 5,) which is carried by a hinged frame, so that the intermediate can be moved out of contact with the pinion whenever it is desired to stop the feed, without interrupting the rotation of the tablet-holder. The hinged frame consists of side bars, 347, which are hinged separably on the tie-rod 302; and are rigidly connected with each other by tie-bars 348 and 349. A spring, 350, under each side bar tends to lift the frame and press the intermediate 345 against the pinion 343. The feed-screw is therefore normally in engagement with the tablet-holder; but can be disengaged at will by pressing upon the tie-bar 348. The friction-wheels 351 and 352 are for reversing the revolution of the feed-screw. The wheel or pinion 352 is simply a hub on the side of the intermediate 345. The wheel 351 presses against the pinion 352, and is mounted on a stud at the end of bent lever 353, which turns upon the screw-stud 354 in line with the stud 346. (See Fig. 5.) The lever 353 thus turns about the axis of the wheel 352, and the wheel 351 may roll over the surface of the wheel 352, so as to be pressed against and thus engage the pinion 343 on the tablet-holder. The short arm of the bent lever is connected by a link, 355, with the stud 356, itself secured fast to the side piece, 300. When, therefore, the tie-bar 348 and side bars, 347, are depressed, the lever, as shown in Fig. 2, is turned to the left, and when it is sufficiently depressed the wheel 351 is held against and engaged by the pinion 343. Motion is now communicated through the wheels 343, 351, 352, 345, and 344, the rotation of the feed-screw is reversed, and a more rapid rotation is imparted to it. The carrier will therefore be moved backward (to the left in Fig. 1) more rapidly than it was advanced. There will ordinarily be not much occasion to use the stop and reversing mechanism in recording. It is for use in reproducing that it has been specially devised. The reproducer (see Figs. 1, 4, 11, 12, and 13) has a style, 357, welded or otherwise fastened to the end of a flexible strip, 358, of thin steel—say three one-thousandths ($\frac{1}{1000}$) of an inch in thickness—so as to project beyond both edges of the same like a hammer-head. The outer end of this style (which should be somewhat more tapering at the point than the recording-style) rubs over the record or tablet. The inner end presses upon a light flat spring, 359, fastened at the lower end to the frame 300 of the reproducer. The strip 358 is soldered into a slit of the ear 361, on the spring, which by bending between the ear 361, and where it is attached to the frame 300 allows the style and strip to be moved in or out, and thus serves to hinge the same to the said frame. The diaphragm 362, of hard rubber about seven one-thousandths ($\frac{7}{1000}$) of an inch in thickness, is pressed against a conical seat in the face of the frame 360 by means of the spring 359, between which and said diaphragm is a little block, 363, of cork. It serves the double function of pressing the diaphragm against its seat, and also of communicating vibrations to it. Cork is used because it is light and conveys vibrations well and has sufficient friction upon the diaphragm and spring to remain in the position in which it may be placed. By leaving it to be held by friction it can be adjusted by the user to give the best effects; but it can be secured by cement or otherwise in the position which the maker or adjuster of the instrument may determine. Preferably it occupies a position intermediate the style 357 and the edge of the diaphragm, as shown; but it can be set directly opposite the style. In the former position there is a certain length of the spring 359 beyond the cork, which length forms a tongue with a very high rate of normal vibration. It absorbs a considerable portion of the small vibrations which produce scratching noises, and it thus makes the articulation more distinct. It also reduces somewhat the loudness of the sounds reproduced, but the increased distinctness more than compensates for any loss in loudness.

Another effect which the tongue has is to return the style more perfectly when it has been pushed out by an elevation on the record. It does this because its normal vibration is quicker than that of the diaphragm or because its amplitude of vibration is larger, or for both reasons. It will be understood that this spring-tongue is compressed by the weight of the reproducer, which is sustained by the style. This weight is actually very small, the frame being made, for lightness, of hard rubber, but in comparison with the strength of the spring-tongue it is considerable. It will be observed that the diaphragm is strained by the spring in addition to the strain due to the weight of the reproducer. The inner end of the style 357 preferably rests in a hole or recess in the spring 359, so that it is prevented from side motion bodily, although capable of rocking on the inner end as a center. The bending of the strip 358 allows this side movement of the

front end of the style to take place with the greatest freedom. A bodily movement of the style sidewise could be permitted, if desired, but a stop should then be used to prevent it from being pushed off the spring 359.

To protect the style and other parts of the reproducer, a guard, 364, fastened to the front of frame 360, and is perforated at the center for the passage of the style. On either side of the center it is bent outward to form horns to support the instrument when placed face downward on a table or flat surface.

The reproducer, consisting of the parts just described, is mounted upon a hollow standard, 365, which is hinged at the bottom to the carrier 366 by means of hollow trunnions 367, fitting in hollow uprights 368 on said carrier. The reproducer-standard 365 is provided with a thumb-piece, 369, which can be pressed to hold up the reproducer in placing the carrier on and removing it from the feed-screw 334. There are front and back screw-stops, 370 and 371, which limit the movement of the reproducer independently of the carrier. This latter is provided with a half-nut to rest upon and engage the feed-screw, the same as the carrier of the recorder. It is not provided with a guard to retain it on the feed-screw because it is considered unnecessary, particularly when a flexible sound-conveyer is employed, as will presently be described. It is provided with a tail or prolongation, 372, which rests upon the tie-bar 348, (see Fig. 4,) so that when this is depressed to stop or to reverse the feed-screw the carrier will turn to the left (the center of gravity being on that side of the feed-screw) and automatically lift the reproducing-style 357 from contact with the tablet 318, in or on which the record is formed. When the tie-bar 348 is released, the springs 350 raise it and turn the reproducer and its carrier to the right, so that the style again makes contact with the record. It will be observed that the pressure of the springs 350 does not force the style against the record, because the reproducer is hinged to its carrier and only its very light weight comes upon the reproducing-style and the record. On the carrier is a brush, 373, which, when the producer is in action, bears upon the record and clears it of dust or shavings of wax or other lightly-adhering matter in advance of the reproducing-style.

The hollow standard 365 serves to convey sound from the lenticular chamber behind the diaphragm into the uprights 368, with the interior of which the coupling 374 communicates. To this coupling a flexible sound-conveyer, 375, is attached at one end, the other end being connected with an upright branch of the tube 304. Thus the sound is conveyed from the interior of the uprights 368 through the coupling 374 and sound-conveyer 375 and tube 304, the flexibility of said conveyer 375 permitting the traverse of the reproducer, as well as the turning of the carrier 366 on the feed-screw 334. The tube 304 communicates with tubes 376 and 377, one at each end of the machine. A hearing-tube is or may be attached to either or both tubes. Preferably the apparatus shown in Fig. 16 is employed It consists of two elastic and flexible hollow branches, 378, each provided at the outer end with a cup, 379, attached by a ball-and-socket joint, and a flexible sound-conveying tube, 380, for connecting both branches with the tube 376 or 377. As shown, there is a hollow metal coupling, 381, at the free end of the flexible tube 380, of such exterior diameter as to fit snugly in the tube which is to receive it. (See Fig. 4.) This coupling is provided with a stop-cock, 387, which can be turned to cut off more or less sound if the reproduction be too loud. This diminution in loudness makes the scratching noises less distracting to a person with a sensitive ear.

In use the cups 379 are placed one over each ear of the listener, the ball-and-socket joint permitting the cup to adjust itself to his head, and the elasticity of the branches 378 drawing them with sufficient pressure to support the apparatus.

The branches may be made of hard vulcanized rubber, in order to secure the requisite flexibility and elasticity; but it is evident that sound-conveying branches having these qualities could be constructed of various materials and in various ways

Instead of applying the tube 380 to the tube 376 or 377, it may be connected directly with the coupling 374, the sound-conveyer 375 being omitted. This has the advantage of diminishing the length of tube between the reproducer and the ear of the listener, but is open to the objection that the reproducer is liable to be pulled from the machine by incautious movements on the part of the listener.

It may be observed that the reproduced sound may be listened to in various ways, and that it is possible to perceive the sounds by applying the ear close to the reproducer itself.

In the modified form of reproducer shown in Fig. 15 the style 382 is made of a thin plate of sheet-steel—say three one-thousandths of an inch in thickness—of the form clearly shown, fastened on edge on the spring 359, being soldered in a slit in the ear 383, and a similar slit in the end of the metal buttons 384, which end projects through the spring 359. This button bears upon the hard-rubber diaphragm 362, and serves to communicate vibrations from the style to it.

In the form of reproducer shown in Fig. 17 the style 390 is interposed between the diaphragm 362 and the flat spring 391. Near each end the style has a rounded shoulder, and the ends themselves are of smaller diameter, so that they may pass through holes in the diaphragm and spring, as shown, the latter pressing upon the shoulders. The spring 391, whose flat side is toward the diaphragm, is attached to the strip 392, which is soldered or otherwise fastened to the post 393. The spring

791 retains the outer or operating end of the style in place while allowing it freedom to move endwise for impressing vibrations upon the diaphragm. Preferably it exerts a light pressure inward, tending to strain the diaphragm, as well as maintain itself in contact with the shoulder on the style. It supplies the place of spring 389 of Figs. 11 and 15. The strip 392, whose edge is turned toward the diaphragm, allows the operating end of the style to move sidewise. It thus supplies the place of strip 388 of Fig. 11, and that which forms the style 382 of Fig. 15.

The construction of Fig. 17 has the advantage over the other forms that there is less material to be moved by the vibrations of the style.

The parts 391 and 392 can most conveniently be made from a round wire by filing the same flat at proper points.

The operation of the machine has practically been explained in the foregoing description in connection with the several parts of the machine, but an explanation will now be given of the operation as a whole. Having prepared a hollow paper cylinder and coated it with the paraffine and beeswax composition, the coated cylinder 318 (which forms the recording-tablet) is placed upon the tablet-holder 305, which for that purpose is detached at one end by releasing the catch 311, and tipped up, as indicated in dotted lines in Fig. 5. The detached end of the tablet-holder is then returned to its bearings in side piece, 301. Having adjusted the rest 329 of the recorder so that the recording-style 326 projects beyond the enlargement 332 the desired distance—say five one-thousandths ($\frac{5}{1000}$) of an inch—the recorder-carrier 333 is placed on the feed-screw 334, near the left end of the same, the guard-block 335 is turned under the screw, and the recorder is made to rest against the recording-tablet, the weight being supported by the rest 329, and the style 326 penetrating the wax coating. The fly-wheel 317 is then turned, revolving the tablet-holder and tablet, and also, but at a less speed, the feed-screw 334. Since the recorder is moved lengthwise of the tablet as the latter is revolved under it, the recording-style traces, or more specifically cuts, in the wax coating a spiral groove whose convolutions are closer together than the threads of the feed-screw. The convolutions may be eight one-thousandths ($\frac{8}{1000}$) of an inch apart. To make a speech record in or on the tablet, the speaker places the lower part of his face in the mouth-piece 338 and says in a clear and moderately loud voice the words to be recorded, the fly-wheel being kept in motion at a uniform speed of say one hundred and sixty revolutions per minute. If it be desired to mark visibly a paragraph on the record, it can be done by lifting the recorder for a short time from the record, then releasing it, and again speaking into the mouth-piece. The sonorous vibrations which the speaker impresses upon the air in the mouth-piece 338 and tube 339 are taken up by the diaphragm 320 and style 326, and the latter cuts a groove in the tablet, which is correspondingly irregular. After the record has been cut over the whole tablet, or over as much as may be desired, the recorder is removed. The tablet is also removed and brushed to remove the wax shavings, and then, or at some future time, is replaced on the tablet-holder of the same or of a similar machine. The reproducer-carrier 360 is placed on the feed-screw 334, the tail 372 resting on the tie-bar 348. The thumb-piece 369 of the reproducer-standard is pressed upon to keep the style 387 or 382 from contact with the record until the carrier has been placed on the screw. It is then released, and the reproducer, falling forward, brings the style into contact with the record. Preferably the grooves are so close together that the ridge between them tapers to an edge on top, so that no matter where the reproducer may be placed the style will enter a groove, and being free to move sidewise will, owing to the sloping sides of the groove, penetrate to the bottom thereof under the action of gravity. The fly wheel being turned at about the speed used in recording, the reproducer will follow the spiral groove cut by the recorder, and will be acted upon by the inequalities or irregularities of the record, and made to reproduce sounds or sonorous vibrations similar to those which acted upon the recorder to produce said inequalities or irregularities in the groove. Each elevation as it passes under the style at first presses the latter outward, and, when the top of the elevation is reached, allows it to be returned inward by the tension of the diaphragm and spring, or of the diaphragm alone. By these alternating movements, repeated for each ascent and descent in the record, and corresponding in extent and rapidity with the length and slope of the ascent and descent, the diaphragm is thrown into vibrations corresponding in form to the sonorous vibrations which caused the irregularities or inequalities. In addition to these vibrations, foreign vibrations, due to various causes, are also impressed upon the diaphragm. These should be disregarded, as far as possible, by the listener confining his attention to the speech-vibrations. They will (in the reproducer shown in Figs. 11 and 12) be measurably taken up by the vibration independently of the diaphragm 362 of the tongue formed by the end of the spring 359, which projects beyond the block 363.

In certain speech-sounds it is found that the diaphragm responds too sluggishly, and that in consequence of this sluggishness the style, if influenced by the diaphragm alone, will not descend to the bottom of a depression in the groove, but will skip across, thus cutting off more or less of the vibration. The tongue of the spring 359 responds more readily than the diaphragm and diminishes the danger of false vibrations. This spring-tongue also absorbs a portion of the speech-vibrations, thus dimin-

ishing the loudness of the reproduced sound; but any loss in this respect will be more than balanced by the improvement in distinctness. The vibrations of the diaphragm being impressed upon the air in the chamber behind the same are conveyed through the standard 365, the uprights 368, the coupling 374, the flexible tube 375, the tube 304, the tube 376 or 377, the tube 380, and the branches 378 to the ears of the listener. Should it be desired to interrupt the reproduction for a time, the tie-bar 348 is pressed lightly, thereby withdrawing the intermediate 345 from contact with the pinion 343 and stopping the rotation of the feed-screw 334. At the same time the reproducer-carrier 366 is allowed by the depression of the tie-bar to turn sufficiently to lift the reproducer-style 357 clear of the record, the front stop, 370, coming in contact with the standard 365 and raising the same. Should one or more words, phrases, or sentences not be understood, the tie-bar 348 is pressed more strongly, so as to bring the wheel 351 into engagement with the pinion 343, and thereby reverse the rotation of the feed-screw. When the reproducer has been carried back beyond the part of the record from which the reproduction was not understood, the tie-bar 348 is released, the style again comes into contact with the record, and the reproduction commences at the point to which the reproducer has been brought back. This repetition of what is not understood can be made as often as desired.

Friction-wheels for communicating motion to the feed-screw are preferred to cog or other toothed gearing, (which could of course be used without departing from the invention,) notwithstanding their liability to slip, because they run smoother and are more easily engaged and disengaged. A slip between the wheels causes the reproducer to be fed faster or slower than the spiral on the tablet permits the style to advance. As a general thing, there is more slip in recording than in reproducing, and consequently the reproducer outruns the style slightly. The style should be given enough side play to compensate for this difference in speed; but if not given the only difficulty is that the style will at length slip across the ridge between the grooves, and thus escape the action of a portion of the record, so that it may be necessary to bring back the reproducer by reversing the feed. The loudness of the reproduction is limited as desired by turning the stop-cock 387 to the desired extent.

In the foregoing description of the machine shown in the drawings, dimensions, proportions, materials, and other details of construction are mentioned with particularity for the purpose of enabling others more readily to make and use the new improvements, and not as limitations of the said improvements, since it is obvious that modifications can be made in details without departing from the spirit of the invention, and that parts of the invention can be used separately.

The terms "recorder" and "reproducer" as used herein include simply means (a style, for example) for acting upon a tablet to form a sound-record, or being acted upon by a sound-record, in connection with means whereby sonorous vibrations can be impressed upon the recording-style or its substitute, or can be received from the reproducing-style or its substitute, and such frame or support as may be necessary to an operative device. As hereinafter employed, they mean a recorder or reproducer of any ordinary or suitable description unless a special form is mentioned, or is necessarily implied from the connection in which the recorder or reproducer is used. For example, some forms of recorder and reproducer would not be suitable for use with a wax-coated tablet. In like manner other terms—such as "tablet," "tablet-holder," "carrier," "sound-conveyer," "gearing," &c.—refer to devices of any ordinary or suitable description, except as otherwise indicated.

The present invention is to be considered as an improvement upon or modification of what is shown and described in the application for Letters Patent of C. A. Bell and myself, filed June 27, 1885, and officially numbered 170,044, so far as they relate to common features, and no claim is made herein to any matter described and shown in that application.

Having now fully described my said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. A recording-tablet for a phonograph, consisting of a hollow cylinder provided with a wax or wax-like coating for receiving the sound-record, substantially as described.

2. A recording-tablet consisting of a hollow cylinder of paper provided with a wax or wax-like coating, substantially as described.

3. The recording-tablet consisting of a hollow paper cylinder coated with a composition of beeswax and paraffine, substantially as described.

4. A tubular self-sustaining tablet for recording sounds or sonorous vibrations, substantially as described.

5. In a phonograph and in combination with a sound recorder or reproducer and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, an elongated cylindrical tablet-holder supported and journaled so that the tubular tablet can be placed on the same, substantially as described.

6. The combination, with a tubular tablet, of the tablet-holder for supporting and rotating the same, substantially as described.

7. A tablet-holder journaled in bearings at both ends and detachable from its support at least at one end, so that a tubular tablet can be slipped over the same, in combination with a sound recorder or reproducer, and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, substantially as described.

8. A tablet-holder detachably connected with its support at one end and provided at the other end with a ball-and-socket bearing, or bearing which permits the said holder to be tilted for placing a tubular tablet on the same, in combination with a sound recorder or reproducer and operating mechanism for causing said recorder or reproducer to trace a spiral line on the tablet, substantially as described.

9. The combination, with the tablet-holder, the side piece or support at one end of the same, and the cap therefor, of the catch or fastening for said cap and the spring for moving the tablet-holder when the catch is released, substantially as described

10. The combination, with the tablet-holder and the ball-and-socket bearing or bearing for permitting the holder to be tilted, of the support and cap at the opposite end of said holder, the catch or fastening for said cap, and the spring lifting the journal from said support when the catch or fastening is released, substantially as described

11. The combination, with the tablet-holder, of the box or sleeve on one journal of the same, the support and cap forming the bearing for said box or sleeve, and the catch or fastening for the cap, substantially as described.

12. The combination, with the tablet-holder, of the box or sleeve held on one journal of the same, the support and cap forming a bearing for said box or sleeve, and the spring whose pressure acts against said box or sleeve, substantially as described.

13. The combination, with the tablet-holder, of the ball-journal and socket-bearing at one end of said holder, the box or sleeve on the journal at the opposite end of said holder, and the bearing for the same, substantially as described.

14. The combination, with the tablet-holder, the sound-recorder, and the feed-screw, of gearing between said holder and feed-screw for revolving the latter at a slower speed than the former, substantially as described.

15. The combination, with the tablet-holder, sound recorder or reproducer, feed-screw, and gearing for revolving the screw, of the carrier for the recorder or reproducer provided with a divided or partial nut for engaging said screw, substantially as described.

16. The combination, with the feed-screw and the carrier for engaging the same, of the movable guard for retaining the carrier in engagement with the screw, substantially as described.

17. The combination, with a feed-screw and a sound recorder or reproducer, of the carrier for the sound recorder or reproducer engaged and also supported by said screw, substantially as described.

18. The combination, with a feed-screw and a sound recorder or reproducer, of the carrier for the recorder or reproducer movable lengthwise of and engaged by said screw and capable of turning on the same as on a journal, substantially as described.

19. The combination, with a tablet and a tablet-holder, of the feed-screw, a carrier mounted on said screw, and the recorder supported on said carrier and resting against the tablet, substantially as described.

20. The combination, with the tablet-holder, feed-screw, and gearing between the same, of the hinged frame upheld by spring-pressure and the devices connected therewith for putting the feed-screw out of action when the said frame is depressed, substantially as described.

21. The combination, with a tablet-holder, feed-screw, and gearing between the two, of the hinged frame upheld by spring-pressure and reversing mechanism connected with said frame for reversing the rotation of the feed-screw relatively to the rotation of the tablet-holder, substantially as described.

22. The combination, with a tablet-holder, a feed-screw, gearing, and an instrument—the reproducer, for example—engaged by said screw, of stop mechanism for putting the feed-screw out of action and at the same time lifting the instrument clear of the tablet, substantially as described.

23. The combination, with a tablet, a tablet-holder, a feed-screw, gearing, and an instrument—the reproducer, for example—engaged by said screw, of reversing mechanism for reversing the rotation of the feed-screw, the said mechanism being connected with said instrument, so that the latter will be lifted clear of the tablet on the reversal of the feed-screw, substantially as described.

24. The combination, with the tablet and the recorder held against the same by yielding pressure, of a rest bearing on said tablet for supporting the recorder, substantially as described.

25. The combination, with the recorder frame and style and the means whereby sonorous vibrations are impressed upon the style, of the rest attached to said frame and arranged close to said style, the latter projecting beyond the rest to act upon the recording-tablet, substantially as described.

26. The combination, with the recorder, of the adjustable rest attached to said recorder for bearing upon the recording-tablet, substantially as described.

27. The combination, with the recording-style, the recorder-frame, and the means whereby vibrations are impressed upon the style, of the rest attached to said frame and adjustable lengthwise of said style, substantially as described.

28. The combination, with the recorder-frame and the rest attached thereto, of the diaphragm and the recording-style mounted directly on said diaphragm, substantially as described.

29. The combination, with the diaphragm, of the cutting-style formed of a wire sharpened at its outer end and carried by said dia-

phragm so as to vibrate with the same, substantially as described.

30. The combination, with the diaphragm, of the cutting-style provided with a screw-threaded shank, and the nut and washer for securing the same to the diaphragm, substantially as described.

31. The combination, with a recorder having a cutting-style, of the rest for bearing upon the recording-tablet, substantially as described.

32. The combination, with the tablet having a wax or wax-like coating to receive the record, of the recorder pressed toward the tablet by yielding pressure and provided with a cutting-style and the rest for bearing upon the tablet and supporting said pressure, substantially as described.

33. The combination, with the recorder, of the sound-concentrator comprising a flaring mouth-piece and a tapering tube forming a continuation of the same, substantially as described.

34. The combination, with the recorder, of the sound-concentrator comprising a mouth-piece of elliptical form and a tapering tube forming a continuation of the same, substantially as described.

35. The combination, with the reproducer, of the brush for clearing the record in advance of the reproducer, substantially as described.

36. The combination, with the recording-tablet having a wax or wax-like coating in which the record is cut, of the reproducer and the brush for clearing the record in advance of the reproducer, substantially as described.

37. A recording-tablet consisting of a hollow cylinder provided with a wax or wax-like coating and having a sound-record cut in said coating, substantially as described.

38. The combination, with the tablet and tablet-holder, of the feed-screw, the gearing, the reproducer-carrier, and the brush, substantially as described.

39. A reproducer having a flexible or flexibly-mounted style movable sidewise independently of the diaphragm or device to which the style communicates vibration, substantially as described.

40. A reproducer having the style attached to or in one piece with a comparatively broad and thin strip placed on edge, said style in consequence of the flexibility of said strip being movable sidewise independently of the diaphragm or device to which the style communicates vibration, but in consequence of the breadth of said strip being practically rigid to pressures in other directions, substantially as described.

41. The combination, with the reproducer-style and diaphragm or device to which said style is to communicate vibrations, of a comparatively broad and thin strip placed on edge and attached to or in one piece with said style, said strip being hinged to the frame, so that the style may be vibrated in the plane of said strip, substantially as described.

42. In a reproducer, the style attached to a thin metal strip breadthwise of the same like a hammer-head, substantially as described.

43. The reproducer-style attached to or in one piece with a broad and thin strip, in combination with a diaphragm or device upon which the reproduced sonorous vibrations are to be impressed and a spring carrying said style and strip, and serving as a hinge to permit them to vibrate, substantially as described.

44. The combination, with the reproducer-style and the diaphragm or device upon which the reproduced sonorous vibrations are to be impressed by said style, of a flat metal spring interposed between the style and diaphragm and forming a yielding connection, through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, substantially as described.

45. The combination, with the reproducer-style and the diaphragm or device upon which the reproduced vibrations are to be impressed by said style, of a metal spring or spring-tongue whose normal vibration is quicker than that of said diaphragm, and whose tension tends to move the style away from the diaphragm, substantially as described.

46. In combination with a diaphragm, a frame having a concave seat for said diaphragm, the walls of said seat converging to an opening in the back, through which the sound may escape, substantially as described.

47. The combination, with the diaphragm and the frame having a concave seat for said diaphragm, of a spring for holding the diaphragm to its seat and for straining the same, substantially as described.

48. The combination, with the diaphragm, its supporting-frame, and the style, of the spring for straining said diaphragm, substantially as described.

49. The combination, with the diaphragm and its supporting-frame, of the spring pressing inward on said diaphragm and the style carried by said spring, substantially as described.

50. The combination, with the diaphragm and its frame, of the spring projecting over said diaphragm, the block between the spring and diaphragm, and the style bearing upon the spring beyond said block, substantially as described.

51. The combination, with the reproducer-style, of the hard-rubber diaphragm and the frame for supporting said diaphragm at the edges, substantially as described.

52. The combination, with a diaphragm and its frame, of a spring projecting over said diaphragm, a style carried by said spring, and a block between the diaphragm and spring, adjustable lengthwise of the latter, substantially as described.

53. The combination, with the reproducer, of the guard fastened over the face of the same, substantially as described.

54 The reproducer provided with a guard

fastened over the face of the same, and curved to form horns upon which the reproducer may rest, substantially as described.

55. The double ear-piece, comprising the elastic and flexible hollow branches provided each with a cup connected with the branch by a ball-and-socket joint, substantially as described.

56. The combination, with the reproducer and the carrier therefor and the feed-screw for moving them, of a sound-conveying tube on the machine-frame and a flexible sound-conveyer between the reproducer and the said tube, substantially as described.

57. The combination, with the reproducer, of the double ear-piece comprising the elastic and flexible hollow branches and the cups jointed to the ends of said branches, substantially as described.

58. The combination, with the feed-screw and the reproducer-carrier supported and capable of turning on said screw, of the reproducer hinged to said carrier and a stop for lifting the reproducer when the carrier is turned in the proper direction, substantially as described.

59. The combination, with the feed-screw and the reproducer-carrier engaging and capable of turning on said screw and provided with an extension or tail, of a movable bar under said tail for upholding the same, so that by depressing said bar the carrier can be turned and lift the reproducer from the tablet, substantially as described.

60. The combination of the feed-screw, the reproducer-carrier mounted thereon and provided with an extension or tail, and the bar under said tail for upholding the same, substantially as described.

61. The combination, with the reproducer-carrier, of the reproducer mounted on a standard hinged to said carrier, said standard being provided with a thumb-piece or device, whereby the reproducer can be held up in placing the reproducer on and in removing it from the machine, substantially as described.

62. The combination, with the tablet, tablet-holder, feed-screw, gearing, reproducer, and reproducer-carrier, of the mechanism for controlling the rotation of said feed-screw the same being connected with said carrier so as to lift the reproducer from the tablet when operated to stop or to reverse the rotation of said screw, substantially as described.

63. The combination, with the tablet-holder and the feed-screw, of the gearing for rotating the feed-screw in the forward direction, the hinged frame for disengaging said gearing when moved a certain distance, and additional wheels connected with said frame, so as by a further movement to engage said wheels and reverse the rotation of said screw, substantially as described.

64. The combination, with the sound recorder or reproducer, the tablet, the tablet-holder, the feed-screw, the gearing for rotating the same in a forward direction, the gearing for rotating the same backward at a greater speed, and mechanism for bringing the latter into action, substantially as described.

65. The combination, with the reproducer and a conveying-tube for the reproduced sounds, of a stop-cock in said tube for moderating at will the loudness of the sounds to be conveyed to the ear, substantially as described.

66. The herein-described improved recording and reproducing machine, comprising the following elements in combination: a hollow cylindrical self-sustaining tablet, a tablet-holder journaled and hinged at one end to the machine-frame and journaled and detachably connected with said frame at the other, a feed-screw, gearing for rotating the said screw in either direction according to the wheels engaged, a hinged frame for controlling the rotation of said screw, and the recording and reproducing instruments with their carriers, substantially as described.

In testimony whereof I have signed the foregoing specification in the presence of two subscribing witnesses.

SUMNER TAINTER.

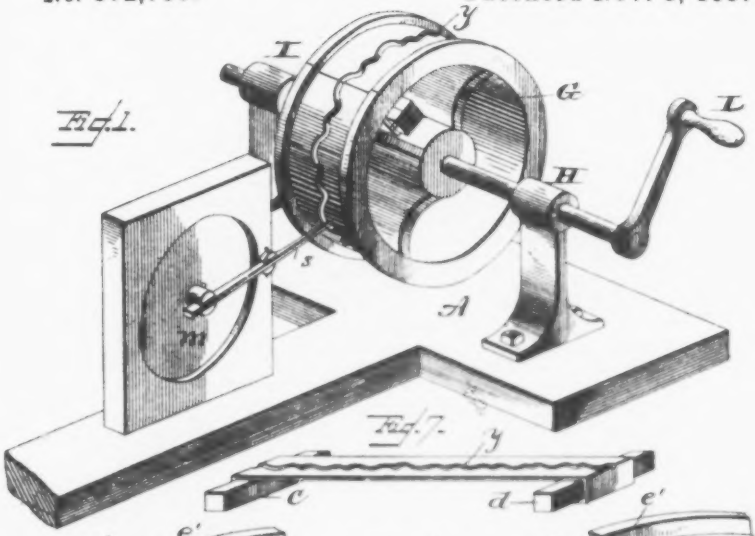
Witnesses:
PHILIP MAURO,
O. J. HEDRICK.

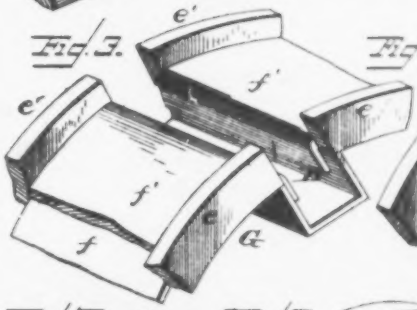
416
(No Model.)

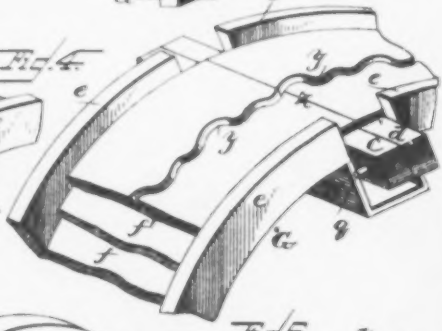
E. BERLINER.

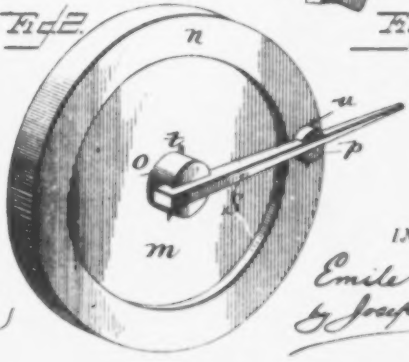
GRAMOPHONE.

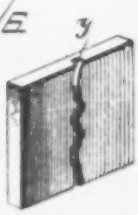
No. 372,786. Patented Nov. 8, 1887.











WITNESSES

J. Ellman

Wm. E. Schraubow

INVENTOR

Emile Berliner.

by Joseph Lyons

Attorney

UNITED STATES PATENT OFFICE.

EMILE BERLINER, OF WASHINGTON, DISTRICT OF COLUMBIA.

GRAMOPHONE.

SPECIFICATION forming part of Letters Patent No. 372,786, dated November 8, 1887.

Original application filed May 4, 1887, Serial No. 237,060. Divided and this application filed September 26, 1887. Serial No. 250,731. (No model.)

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Gramophones, of which the following is a specification.

This invention has reference to a novel method of and apparatus for recording and reproducing all kinds of sounds, including spoken words, and is designed to overcome the defects inherent in that art as now practiced and in the apparatus used therefor.

By the ordinary method of recording spoken words or other sounds for reproduction it is attempted to cause a stylus attached to a vibratory diaphragm to indent a traveling sheet of tin-foil or other like substance to a depth varying in accordance with the amplitudes of the sound-waves to be recorded. This attempt is necessarily more or less ineffective, for the reason that the force of a diaphragm vibrating under the impact of sound-waves is very weak, and that in the act of overcoming the resistance of the tin-foil or other material the vibrations of the diaphragm are not only weakened, but are also modified. Thus while the record contains as many undulations as the sounds which produce it, and in the same order of succession, the character of the recorded undulations is more or less different from those of the sounds uttered against the diaphragm. There is, then, a true record of the pitch, but a distorted record of the quality of the sounds obtained. The simple statement that the material upon which the record is made resists the movement of the diaphragm is not sufficient to explain the distortion of the character of the undulations, for if that resistance were uniform, or even proportional to the displacement of the stylus, the record would be simply weakened, but not distorted; but it is a fact that the resistance of any material to indentation increases faster than the depth of indentation, so that a vibration of greater amplitude of the stylus meets with a disproportionately greater resistance than a vibration of smaller amplitude. For this reason loud sounds are even less accurately recorded than faint sounds, and the individual voice of a loud speaker record, and then reproduced by the phonograph cannot be recognized. With a view of overcoming this defect it has been attempted to engrave instead of indent a record of the vibrations of the diaphragm by employing a stylus shaped and operating like a chisel upon a suitably-prepared surface; but even in this case the disturbing causes above referred to are still present. In addition to this, if in the apparatus of the phonograph or graphophone type it is attempted to avoid the disturbing influence of the increase of resistance of the record-surface with the depth of indentation or cut as much as possible by primarily adjusting the stylus so as to touch the record-surface only lightly, then another disturbing influence is brought into existence by the fact that with such adjustment, when the diaphragm moves outwardly, the stylus will leave the record-surface entirely, so that part of each vibration will not be recorded at all. This is more particularly the case when loud sounds are recorded, and it manifests itself in the reproduction, which then yields quite unintelligible sounds.

It is the object of my invention to overcome these difficulties by recording spoken words or other sounds without perceptible friction between the recording-surface and the recording-stylus, and by maintaining the unavoidable friction uniform for all vibrations of the diaphragm. The record thus obtained, almost frictionless, I copy in a solid resisting material by any of the methods hereinafter described, and I employ such copy of the original record for the reproduction of the recorded sounds.

Instead of moving the recording-stylus at right angles to and against the record-surface, I cause the same to move under the influence of sound-waves parallel with and barely in contact with such surface, which latter is covered with a layer of any material that offers a minimum resistance to the action of a stylus operating to displace the same, all substantially in the manner of the well-known phonautograph by Leon Scott. All this will more fully appear from the following detailed description, in which reference is made to the accompanying drawings, which illustrate one of the numerous forms which my improved apparatus may assume, and in which—

Figure 1 is a perspective view of my recording and reproducing apparatus; Fig. 2, a like

view of the recording and reproducing diaphragm with its stylus; Fig. 3, a similar view of a portion of the support for the record-surface; Fig. 4, the same view with the record-surface applied; Fig. 5, a plan view of a phonautographic record; Fig. 6, a perspective of a phonautographic record copied in solid resisting material; and Fig. 7, the copied record mounted, ready for application to the support.

The general arrangement of the parts is best illustrated in Fig. 1, in which a T-shaped base-plate, A, is shown, upon which two standards, H I, serving as journal-bearings for the shaft of drum G, are mounted. The drum G may be constructed with flanges *c c'*, which project beyond the cylinder-surface *f*, and from the edges of a gap, B, left upon the cylinder-surface extend the side walls of box K, as shown. A thin layer of felt or other yielding elastic substance is placed upon the cylinder-surface and is bent over the edges of the gap and secured to the side walls of the box K. This layer of elastic material is designed to serve as the support for the record-surface both in recording and reproducing.

For recording I employ a thin strip of paper, parchment, metal, or any other suitable substance, which is secured at both ends to bars *c d*, in the manner shown in Fig. 7, with reference to a copy of a record, and is then placed upon the elastic support *f'*, with the bars *c d* entering into but projecting at both end beyond the box K, as illustrated in Figs. 1 and 4, with reference to an engraved copy of a record. Bolts *q*, passing through the projecting ends of bars *c d*, are employed to draw the record strip tightly about the drum, and the length of the strip is such that the ends of the same meet as nearly as practicable upon a straight line, *z*. The record-sheet is then prepared to receive the record by covering its surface with a thin layer of any substance which is easily removed by the action of the recording-stylus. I may use lamp-black, which is deposited by placing a smoky flame under the record-strip and by slowly turning the drum until all parts of the strip are covered with the deposit. It is well known that a layer of lamp-black thus deposited, while it adheres well to the surface of a solid body, is nevertheless easily removed from the same. It requires only an exceedingly small force to draw a plainly-visible line upon such surface, owing to the fact that the spicules of carbon of which lamp-black is composed are only loosely superimposed upon each other, and are exceedingly light. All this has long since been recognized and utilized in the production of phonautographic records, and I take advantage of these facts in my improved method of recording and reproducing sounds.

The diaphragm *m* is mounted in a frame, *n*, with its plane at right angles to the axis of drum G. A post, O, is fixed to the center of the diaphragm, and a slot in said post receives one end of stylus S, which is pivoted in the post by a pin, *t*. The stylus extends over and beyond the frame, with its free end barely in contact with the record-surface, and is also pivotally supported in a slot in a post, *p*, secured to the frame by means of a pin, *u*, as shown in Figs. 1 and 2. It will now be seen that the stylus is in effect a lever having its fulcrum in the pin *u*, and that its free end can only move in lines practically parallel to the record-surface. If it is now desired to produce a record of sounds the drum is slowly and uniformly rotated by means of crank L, or by any other suitable means, and sounds are uttered or directed against the diaphragm. Under the impact of the sound-waves the diaphragm is set into vibrations, whereby the free end of the stylus is also caused to vibrate to the right and left of its normal position, removing at the same time an undulating line, *y*, of lamp-black from the record-surface, as indicated, greatly exaggerated, in Fig. 5. Since in this operation the stylus only penetrates a uniform layer of loosely-heaped carbon spicules and barely touches the record-surface, it is clear that the slight friction at the free end of the stylus will be uniform, whatever be the amplitude of vibration. Consequently the vibrations of the diaphragm will not be modified or changed by the reaction upon the same of a sensible and varying resistance, as is the case in all other mechanical sound-recorders.

Having thus obtained an accurate phonautographic record, the same may be fixed by applying a thin solution of varnish of any kind which dries very rapidly and which does not obliterate or change the record.

If in this process the deposit of lamp-black be made thick enough, the line drawn by the stylus would represent a groove of even depth, preserving all the characteristics of the sounds which produced it and which may be handled and touched with impunity. The latter is then removed from the drum and may be preserved any length of time without danger of its being disfigured. This record I then copy in solid resisting material, preferably metal, either by the purely mechanical process of engraving, or by chemical deposition, or by photo-engraving. I prefer the last-named process, which enables me to produce the most accurate copy of the original record in copper, nickel, or any other metal without in any way or manner affecting the original record. The copy thus obtained, which may be multiplied to any desired extent, is a grooved wave-line upon a strip or sheet of copper or other metal, as shown in Figs. 1, 4, 6, and 7, and for the reproduction of the recorded sounds it has the advantage over the ordinary records in tin-foil, wax, &c., that it is not sensibly attacked by the reproducing-stylus, and will stand an indefinite number of reproductions without the slightest variation in the accuracy and loudness of the reproduced sounds.

The copied record is fixed at both ends to the bars *c d*, as shown in Fig. 7, and is placed

upon the elastic support f' upon the drum in the same manner as has been described with reference to the original record-strip, and as is illustrated in Figs. 1 and 4. Care must be taken that the two ends of the undulatory groove y meet exactly, as will be readily understood. This condition of the apparatus is shown in Fig. 1 with the engraven record upon the drum and the free end of the stylus entering the undulatory groove. If, now, the drum is rotated with uniform speed, the end of the stylus will be forced to follow the undulations of the groove y, and the diaphragm will be vibrated positively in both directions in strict accordance therewith, and will therefore reproduce the exact sounds which originally produced the record. This peculiarity of positive vibratory movement in both directions of the diaphragm is a feature which also distinguishes my method and my apparatus from others heretofore used.

In the phonograph and graphophone the end of the reproducing-stylus which bears upon the indented or engraved record has a vertical upward and downward movement. It is forced upwardly in a positive manner by riding over the elevated portion of the record, but its downward movement is effected solely by the elastic force of the diaphragm, which latter is always under tension. In my improved apparatus the stylus travels in a groove of even depth and is moved positively in both directions. It does not depend upon the elasticity of the diaphragm for its movement in one direction. This I consider to be an advantage, since by this method the whole movement of the diaphragm is positively controlled by the record, and is not affected or modified by the physical conditions of the diaphragm, which conditions necessarily vary from time to time and constitute some of the causes of imperfect reproduction of recorded sounds.

In practicing my method of recording and producing sounds I am not limited to the use of the identical apparatus herein shown and described. This apparatus may be varied indefinitely without seriously impairing its utility for the purposes in view. Thus it is not absolutely necessary that a diaphragm should be used for receiving the impact of sound-waves in recording and for remitting sounds in reproducing. Any sonorous body of whatever shape and material may be used in lieu of a diaphragm proper. The recording surface need not be mounted upon a drum, but may be supported in any suitable manner upon a support of any description which is adapted to move the same under the stylus evenly and with approximately uniform speed. Nor do I confine myself to the use of lamp-black as a substratum for the phonautographic record, although I have found this substance to yield excellent results. Any other substance which adheres well to the support and may at the same time be removed from the same with a minimum force may be employed.

While I have found the process of photo-engraving to yield admirable copies of the phonautographic record, I do not mean to confine myself to this process to the exclusion of other processes for copying and multiplying the original record in solid resisting material; and it will be readily understood that the details of construction of my apparatus and the manipulations of the same may be greatly changed without departing from the fundamental idea of my invention.

I do not herein claim the apparatus shown and described, either generically or specifically, as a whole or in part, since the same forms the subject of another application for patent previously filed by me and of which this is a division.

What I do claim, and desire to secure by Letters Patent, is—

1. The method or process of recording and reproducing spoken words and other sounds, which consists in first drawing an undulatory line of even depth in a traveling layer of non-resisting material by and in accordance with sound-vibrations, then producing the record thus obtained in solid resisting material, and finally imparting vibrations to a sonorous body by and in accordance with the resisting record substantially as described.

2. The method or process of reproducing sounds recorded phonautographically, which consists in copying the phonautographic record in solid resisting material, and then imparting vibrations to a sonorous body by and in accordance with the copy of the orignal record, substantially as described.

3. The method or process of reproducing sounds recorded phonautographically, which consists in copying the phonautographic record in solid resisting material by the process of photo engraving, and then imparting positive to and fro movements to a sonorous body by and in accordance with the copy of the original record, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMILE BERLINER.

Witnesses:
JULIUS SCHGER,
JACOB G. COHEN.

420
(No Model.)

6 Sheets—Sheet 1.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

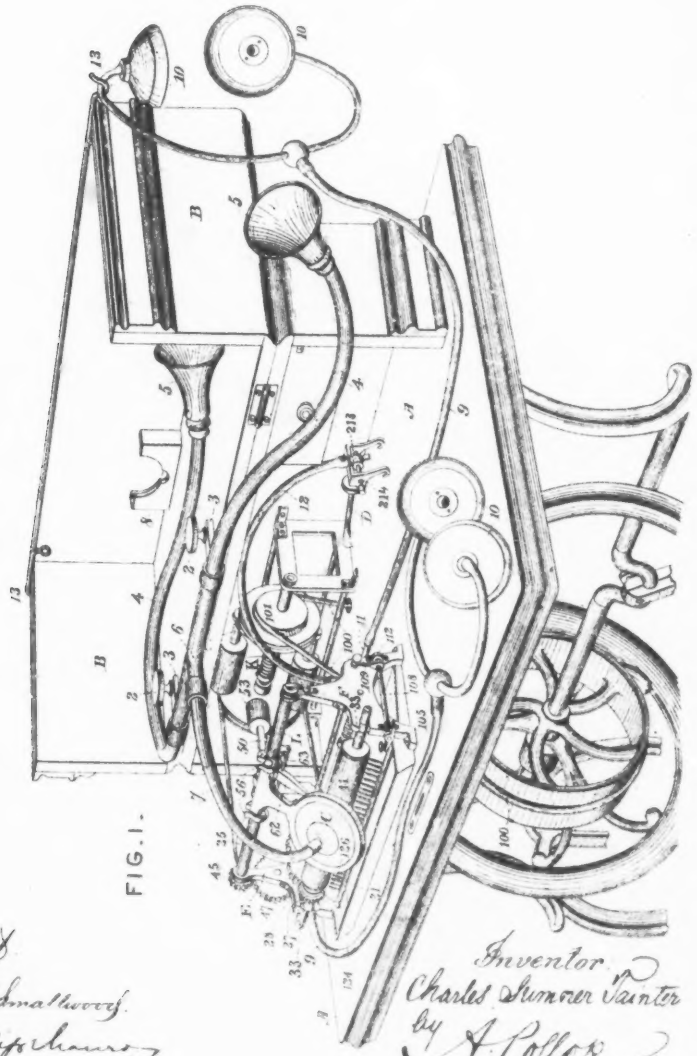


FIG. 1.

Attest
Geo. T. Swallwood.
Philip Sharon.

Inventor
Charles Sumner Tainter
by A. Pollok
his attorney.

421

(No Model.)

6 Sheets—Sheet 2.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

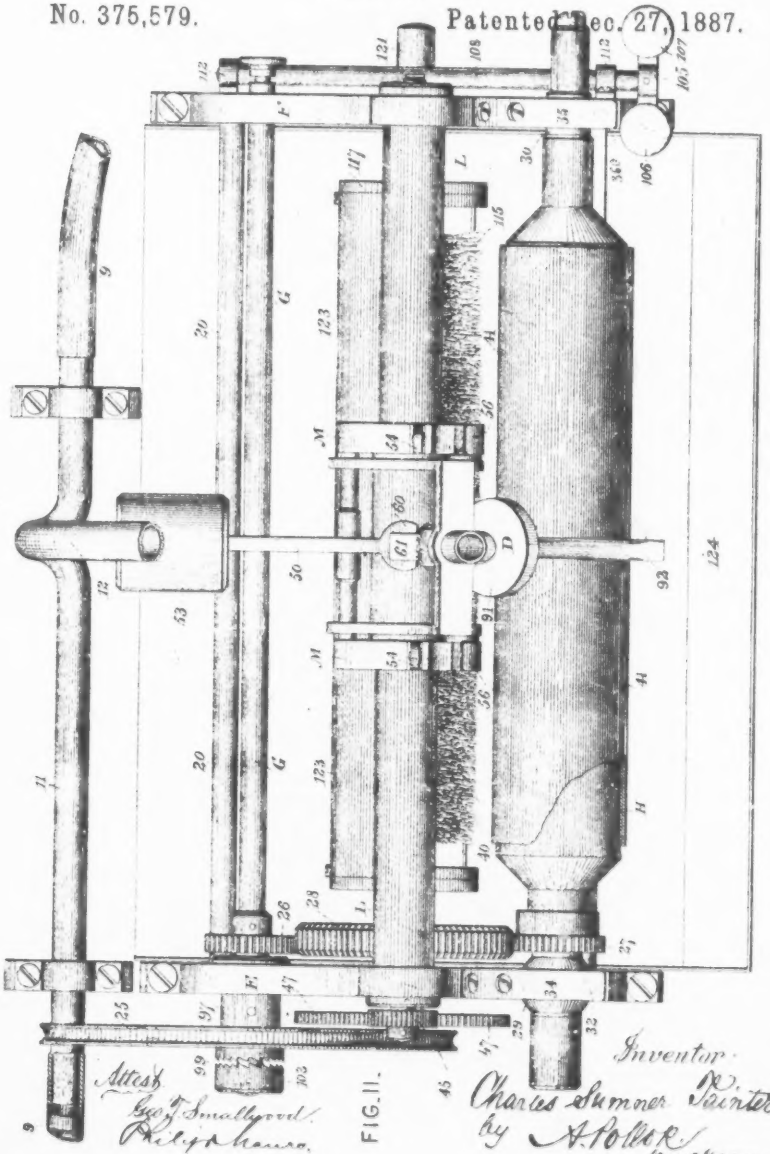


FIG. II.

Witnesses
Geo. J. Smallwood
Philip A. Brown.

Inventor
Charles Sumner Tainter
by A. Pollok
his attorney

422

(No Model.) 6 Sheets—Sheet 3.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

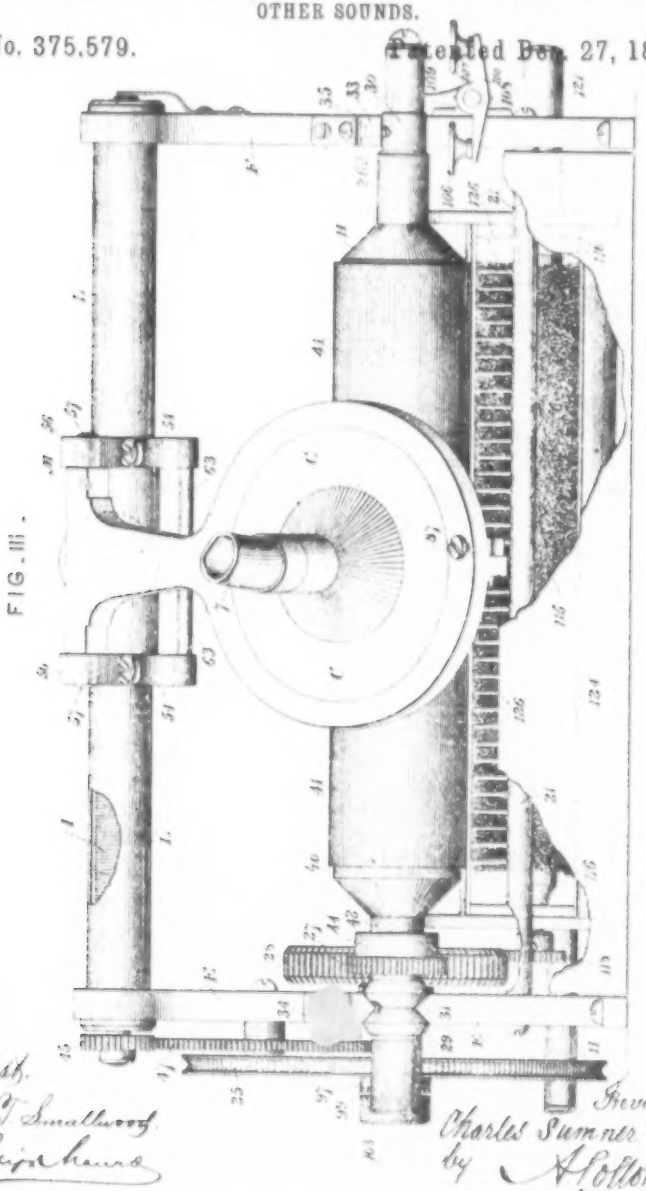


FIG. III.

Attest.
Geo. T. Smallwood.
Philip Hanna

Inventor:
Charles Sumner Tainter
by A. Pollok
his attorney.

423

(No Model.)

6 Sheets—Sheet 4.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

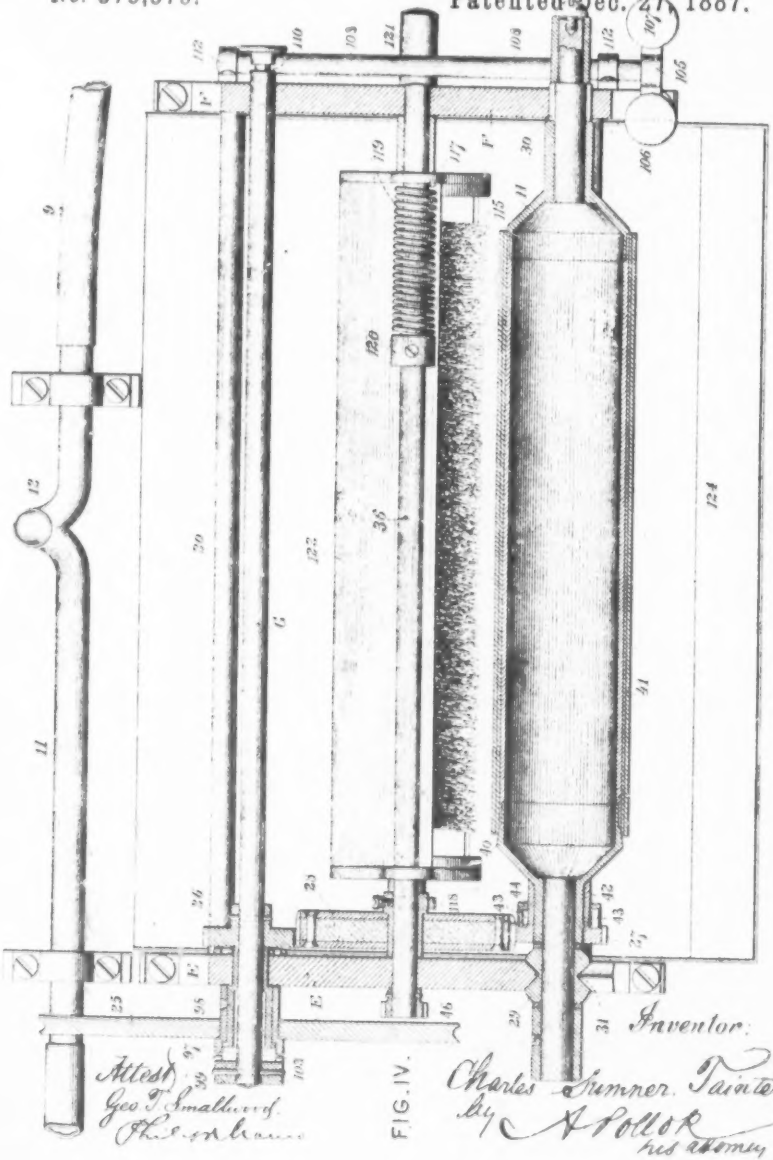


FIG. IV.

Attest:
Geo. T. Smallwood
H. C. Goodwin

Inventor:
Charles Sumner Tainter
by A. Pollok
his attorney

4
R
1

424
(No Model.)

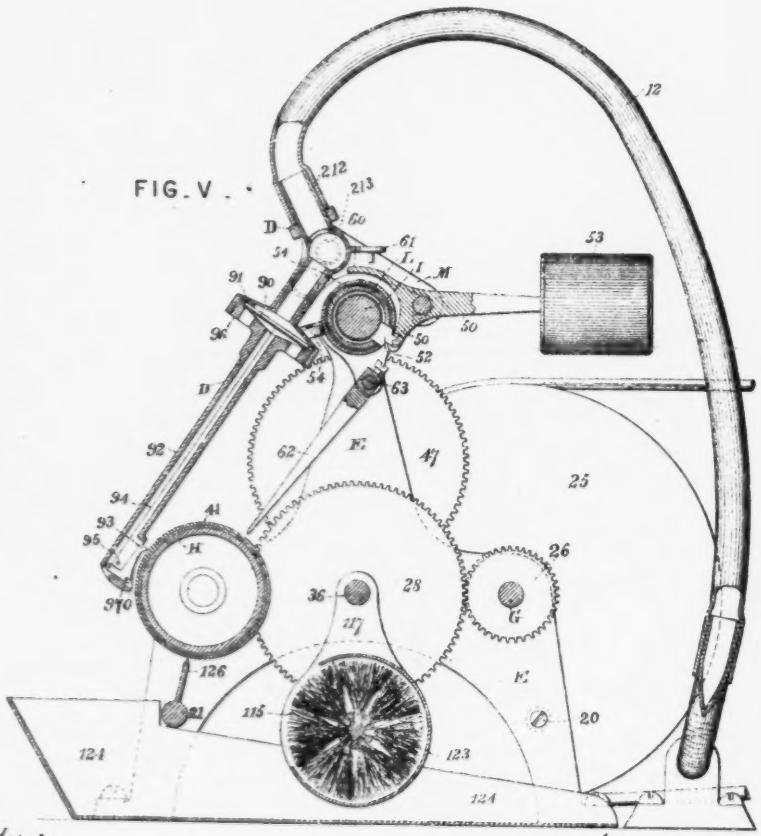
6 Sheets—Sheet 5.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

FIG. V.



Attest:
Geo. T. Smallwood.
Philip Adams.

Inventor:
Charles Sumner Tainter
by A. Pollok
his attorney.

425

(No Model.) 6 Sheets—Sheet 6.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 375,579. Patented Dec. 27, 1887.

FIG. VII.

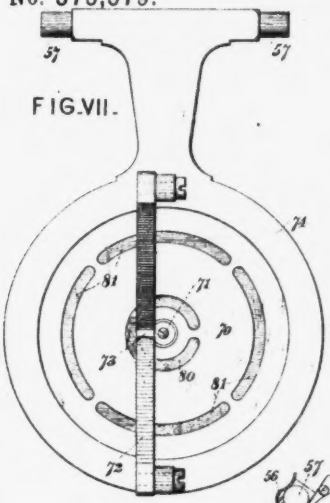


FIG. VIII.

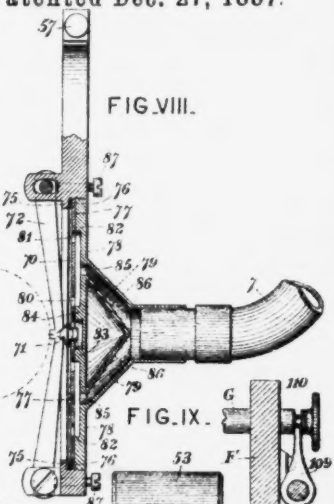
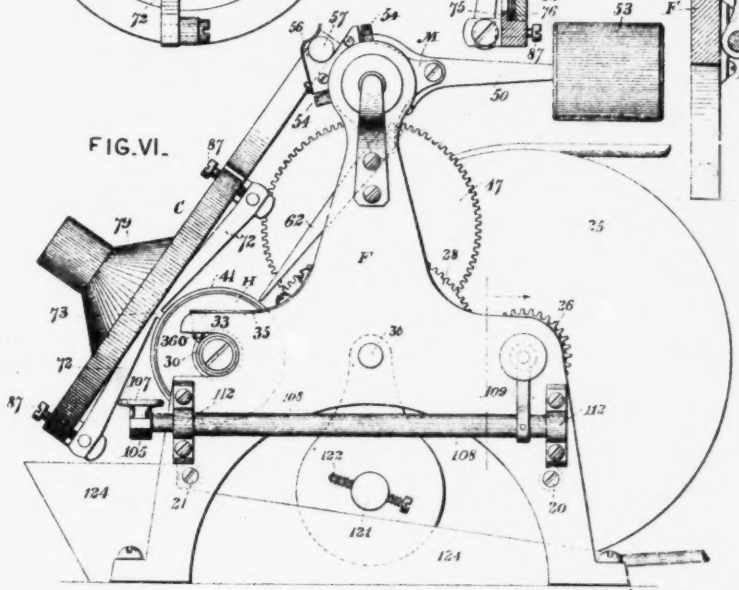


FIG. IX.

FIG. VI.



Attest:
Geo. T. Smallwood.
Philip Mauro

Inventor
Charles Sumner Tainter by
Pollok
his attorney.

UNITED STATES PATENT OFFICE.

CHARLES SUMNER TAINTER, OF WASHINGTON, DISTRICT OF COLUMBIA

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

SPECIFICATION forming part of Letters Patent No. 375,579, dated December 27, 1887.

Application filed July 7, 1887. Serial No. 243,601. (No model.)

To all whom it may concern:

Be it known that I, CHARLES SUMNER TAINTER, a resident of Washington, in the District of Columbia, have invented a new and useful Improvement in Apparatus for Recording and Reproducing Speech and other Sounds, which improvement is fully set forth in the following specification.

This invention relates more particularly to apparatus for recording and reproducing speech and other sounds, known as "graphophones," and comprises certain improvements upon the apparatus described in Letters Patent No. 341,288, granted to me May 4, 1886, and upon instruments of the same type. As described in said patent, the record or "phonogram" is cut or graved by a cutting style in a tablet, consisting of a paper tube or cylinder provided with a coating of wax or wax-like composition, the tablet being mounted on a rotating cylinder or tablet-holder and the recorder or style being advanced lengthwise of the tablet-holder by means of a feed-screw, so as to trace on the tablet a spiral line.

The present invention has for its object to simplify and improve the construction of the apparatus, to render it more complete and convenient for practical use, and to increase its efficiency in point of accuracy and distinctness in recording and reproducing speech and other sounds.

The apparatus is mounted upon a stand or table, and is adapted to be driven by foot-power, or by a small water, spring, electric, or other suitable motor. Upon the stand or table are clamped two or more flexible tubes, terminating in mouth-pieces. At the other end the tubes communicate through a socket and single tube with the recorder. This arrangement is convenient for recording a conversation between two or more persons, as in taking depositions of witnesses. A bracket or holder is provided for receiving the recorder, which can be readily detached from its carriage. Hooks are also provided for hanging the hearing-tubes when not in use. These arrangements conduce greatly to the convenience of the apparatus in practical use.

Heretofore the tablet-holder was on the main shaft. It was provided with a ball-bearing at one end and detachably held in its bearing at the other, so that it could be tilted up to remove and replace the tablet. In the present invention the tablet-holder is on an independent shaft and is driven from the main shaft by positive gearing. This simplifies the construction of the apparatus. It also enables the tablet-holder to be readily removed bodily from the machine, which is desirable both to give access to other parts and to enable a fresh tablet to be inserted with the least possible delay.

As this improvement is carried out herein, forked supports are provided in the front of the frame in which the tablet-holder can be readily inserted. The latter has loose collars, one at each end, which fit in the supports and constitute journal-boxes for the shaft. Spring-latches on the frame hold these collars in place, and one of the collars is grooved for engagement with the support, which is beveled to an edge, whereby end motion of the holder is prevented. As the spiral lines formed by the recorder are very close together, it is of the utmost importance to prevent the least endwise movement of the tablet-holder. The tablets are designed to fit the holder accurately, and heretofore they have been simply slipped on, being held in place by friction. As the tablets are apt to vary somewhat in size, it is preferred to make them a trifle larger than the holder and to make the latter at one end increasing gradually to a little larger diameter, so that the tablet can be pressed toward that end sufficiently to insure a tight fit.

In using ordinary spur-gearing to rotate the holder it is found that the motion of the latter is not absolutely uniform, but proceeds by jerks as one tooth strikes the next. Though this irregularity is very minute and not ordinarily observable, it becomes manifested in the operation of the graphophone. This difficulty is entirely overcome by connecting the driven gear of the tablet-holder with its shaft by a yielding connection. In practice a tolerably stiff spring has been used with excellent results.

Heretofore the carriage of the reproducer and recorder rested directly on the feed-screw. The latter therefore served as a way or track for the carriage. To this construction a lateral shaking or wabbling was incident, which, though actually very slight, it is desirable to avoid. The carriage is now mounted on a

smooth way or track independent of the feed-screw. Preferably the way or track is a fixed tube and the feed-screw is placed within it. The carriage carries a nut which engages and is driven by the thread of the feed-screw. The connection between the nut and carriage is a lever-arm passing through a longitudinal slot in the tubular track. The lever carries a weight which serves both to press the nut against the screw and also to counterbalance the weight of the recorder or reproducer and its accessories. The carriage in the present invention is a permanent part of the apparatus, being used with both recorder and reproducer. Preferably the carriage has small anti-friction rollers in contact with the cylinder, and these are arranged relatively to the nut to insure the greatest freedom of motion to the carriage. The lever-arm, carrying the nut and weight, and the tail-piece of the reproducer have each a finger-piece, which, when the reproducer is in place, are in such position as to be simultaneously operated to raise the nut from the screw and the style from the record, enabling the carriage to be moved back or forward, as desired. To insure accurate setting, an indicator-finger with its point close to the surface of the tablet-holder is attached to the carriage.

As heretofore made the recorder did not act as efficiently in recording sounds of high pitch as in recording sounds of lower pitch. This is believed to be due to the fact that when the sound-waves impinge directly against the center of the diaphragm the latter does not act as a unit, for if the sounds are sufficiently high two or more waves in opposite phases may, owing to the length between the center and circumference of the diaphragm, be acting upon it at the same time, and a differential effect is the result instead of the full force of the wave. This difficulty may be overcome by constructing the sound-conveying passage to the diaphragm in such manner that the atmospheric vibrations will act simultaneously upon the whole surface of the diaphragm. The best embodiment of this principle would be to construct a large air-chamber of conical form in front of the diaphragm, communicating at its apex with the mouth-piece; but this plan is not feasible, because the vibratory air-space in front of the diaphragm must be made very thin, or otherwise a disagreeable hollow quality is manifested in the reproduced sound. The object sought, however, may be practically attained without dispensing with the thin air-space, which is found to be advantageous, by dividing the sound-conveying passage as it approaches the diaphragm into a number of branches equal in length and communicating with different points on the surface of the diaphragm, whereby the latter is caused to vibrate with practical uniformity in every part, even with sounds of high pitch. This improvement obviously permits the use of a larger diaphragm than could heretofore be used with advantage, and it is applicable to other apparatus employing a diaphragm operated by sonorous vibrations.

Successful reproduction from graphophonic records which have been properly made depends largely upon the sensitiveness of the reproducing-style and its ability to follow closely the irregularities of the record, bearing always on it with uniform pressure and not skipping from one elevation to the next, as is the tendency. The elevations and depressions of the sound-record being so minute, and following in such rapid succession, make it difficult to insure that the point of the reproducing-style shall descend fully into each depression.

Heretofore the standard of the reproducer has been pivoted at one end and at the other provided with the diaphragm and style, the reproducer resting by its own weight upon the record, and being thus left free to follow its irregularities. To assist, further, its action a light spring has been arranged to bear upon the style and insure its quick return after passing an elevation in the record. It is found in practice that the weight of the diaphragm and mountings upon the free end of the reproducer-standard is too great to secure the best results, and that the device is rendered more efficient in action by reducing this weight. To this end the diaphragm is now placed nearer the other end of the standard, and therefore falls mainly on the fulcrum of the standard, instead of on the record, and it is connected with the style by a thread.

The style itself consists of a lever on one arm of which is the point that rests on the record, and to the other arm of which the thread leading from the diaphragm is attached. By this construction the pressure of the reproducer on the record is greatly reduced and the style is made to follow the record more accurately. Moreover, when the lever constituting the style rests upon the record, the diaphragm through the thread is pulled toward the style, and thereby held under tension. This tension increases as the style ascends a ridge and reacts to compel it to enter the succeeding depression. As before, the style is made flexible laterally to enable it readily to follow the grooves in the bottom of which the record is formed.

For convenience in stopping and starting the machine without interrupting the operation of the motor a clutch mechanism is combined with the main shaft. The clutch can be operated by a key-lever conveniently placed near the front of the machine. This contrivance is of great utility in transcribing from the record on a type-writer, for instance, it being, of course, difficult for the operator to transcribe as rapidly as the record is reproduced. By means of the clutch mechanism the machine can be stopped after a sufficient number of words have been reproduced until the latter have been transcribed or repeated to another person, when the machine can be instantly started again.

Heretofore the fine wax thread or shaving removed by the cutting-style has been brushed off by hand, and its entire removal has been further insured by attaching a small brush to sweep over the record in front of the reproducer. In the present apparatus a rotary brush is employed having on its shaft a pinion which can be engaged with one of the gears at the same time that the brush touches the surface of the tablet. The brush is preferably made a permanent part of the machine, being carried by a swinging frame attached to one of the shafts. When the record has been cut, the brush can be swung into contact with the tablet, and, by a slight endwise movement, a pinion carried by the brush-spindle is thrown into gear with one of the spur-wheels, and the brush is thereby rapidly rotated while the tablet revolves, completely removing the wax shavings, which fall into a tray placed under the machine. The wax thread or shaving has a tendency to wrap itself around the tablet as the latter revolves, thereby interfering somewhat with the operation of the apparatus. This is now prevented by a comb or saw-toothed plate placed lengthwise of the tablet, with its teeth in close proximity to the surface of the latter.

In addition to the improvements above indicated the invention includes certain new details of construction and combinations of parts, which will be hereinafter fully pointed out.

Having now explained the general principle of the invention, the best mode contemplated of carrying the same into effect will now be described in connection with the accompanying drawings, which form part of this specification.

Figure I is a perspective view of the apparatus arranged upon a stand or table, the recorder being shown in its operative position; Fig. II, a plan view of the graphophone proper; Fig. III, a front elevation with parts of the tray broken away to show the parts behind. Fig. IV is a sectional plan view; Fig. V, a vertical section in elevation looking to the left and showing the reproducer in place. Fig. VI is an elevation of the right end, Fig. II, of the machine, showing the recorder in place. Fig. VII is a bottom view of the recorder. Fig. VIII is a central longitudinal section thereof, and Fig. IX is a detail view of a portion of the clutch mechanism.

Referring to Fig. I, A is the stand or table upon which are placed the working parts of the apparatus. The stand A has a hinged lid, B, which in use is thrown back, forming a shelf. To the front edge of this shelf are attached by clamp-screws 2 the holder 3 for flexible tubes 4. Two tubes are shown, but a greater number could be applied in the same way. At their outer ends the tubes 4 terminate in mouth-pieces 5, and at the other ends they connect with a hollow bifurcated socket 6, connected by a tube, 7, with the recorder C. At the rear of the shelf B is a bracket, 8, in which the recorder C is placed when not in use, so that, with its attachments, it is entirely out of the way while reproducing. The arrangement is found to be of great utility in recording conversations and in taking depositions. The reproducer D is in like manner provided with two hearing-tubes, 9, terminating in ear-pieces 10, such as described in the Letters Patent aforesaid. These tubes 9 connect with opposite ends of a metal tube, 11, screwed to the stand A, from which a flexible tube, 12, leads to the reproducer D. Hooks 13 are pivoted to the back of lid B, and upon them the tubes 9 are hung when not in use. These hooks can be turned inside the lid B when the latter is to be closed.

The motor for driving the graphophone may be located beneath the stand or table A, and may be a treadle, for example. Power is transmitted from such motor by a belt, 100, to the pulley 101 of a speed-regulator, K. The latter may be of any suitable construction, and, as it forms no part of the present invention, need not be particularly described. Its object is to prevent the graphophone from being driven beyond a determined maximum speed, regardless of the speed of the motor.

Referring now to Figs. II to IX, which show the graphophone proper, the frame-work of the apparatus consists of two uprights or standards, E F, and tie-rods 20 and 21. The main shaft G is supported in bearings in the uprights E F. It is driven by the pulley 25, through which it is rotated from a suitable motor by a belt, and it carries a spur-gear, 26, which transmits motion to the other working parts. The tablet-holder H has a gear, 27, which is driven by gear 26 through an intermediary, 28, on shaft 30. The gear 28 is formed of a disk of leather or other suitable material clamped between two metal disks, the object being to prevent noise in operation. Tablet-holder H is detachably supported in a forked support in the front of uprights E F. It has at the ends loose collars 29 and 30, which, when the tablet-holder is in place, are in contact with the frame, and they constitute the bearings or journal-boxes in which the holder revolves, being held stationary in operation. Collar 29 is formed with a groove, 31, and the recess in which it rests is provided with an edge that enters this groove and prevents end motion of the tablet-holder. The pin 32 passes through a hole in the projection 33 of the upright E, and is pressed down by a leaf-spring, 34, which holds the pin against the collar 29 with sufficient pressure to keep the tablet-holder in place. A similar spring-latch, composed of the spring 35 and the pin 360, (see Fig. VI,) is arranged on the upright F to act upon the collar 30. The surface of the latter is smooth. The construction shown permits the tablet-holder to be instantly removed bodily from the machine and as quickly put back in place, thereby avoiding any considerable delay in the use of the machine when a fresh tablet has to be inserted. The tablet-holder

increases at one end to a slightly-larger diameter, as shown at 40, Figs. III and IV, so that the tablet 41, being pressed toward that end, will be held sufficiently tight to prevent slipping, even though the tablet fits quite loosely with respect to the main portion of the holder.

The gear 27 is fixed not directly to the tablet-holder H, but to a collar, 42, mounted loosely on the spindle of said holder. This collar is connected with the holder by a curved spring, 43, so that the connection between the holder and its gear is a yielding one. The curved spring 43 extends more than half-way around the collar, being fastened at one end to the latter and at the other to the tablet-holder, the collar 42 being cut away to permit this connection to be made. The object of this is to prevent minute vibrations being imparted to the tablet from the toothed gearing and to insure absolute uniformity of motion. Such vibrations are absorbed or taken up by the spring 43. The spring is covered by the sliding cap 44.

The feed-screw I is placed near the top of the apparatus and is supported in bearings in uprights E F. It carries a pinion, 45, which is driven by the main shaft through gear 26, intermediary 28, pinion 46 on the same shaft, 36, that carries the gear 28, and spur-gear 47. The feed-screw I is thus driven at a much lower speed than the tablet-holder H.

Feed-screw I, Fig. V, is inclosed in a hollow tube, L, which forms the guide way or track for the carriage M. To the latter is pivoted a lever-arm, 50, which extends to the rear of tube L. This tube has a slot therein which extends lengthwise of the sleeve to the limits of the movement of the carriage in both directions. The arm 50 carries at its end the segment of a nut, 52, having threads corresponding in pitch to those of the feed-screw I, which it engages. The nut 52 is held in engagement with the feed-screw by the pressure of weight 53, which is also carried by lever-arm 50.

The carriage M is designed to slide freely on the guide tube or way L, which it surrounds. It carries four small anti-friction wheels or rollers, 54, which are in contact with the surface of the tube L, the carriage itself not being in contact with the tube at all. The upper and lower pairs of wheels 54 are placed about one hundred degrees apart with respect to the circumference of the tube L, and they are about equidistant from nut 52, so that the bearing-points of the carriage are nearly equidistant and its pressure evenly distributed around its axis, thereby reducing friction to a minimum.

The thread of the feed-screw may be cut away at the right-hand end to stop the carriage when it reaches the end of its movement.

The carriage has in front a pair of sockets, 56, adapted to receive the trunnions 57 of the recorder C or reproducer D. The carriage M is a permanent part of the apparatus, being used with both recorder and reproducer. As the weight 53 is at the rear of the carriage, it not only acts to keep the nut 52 in engagement with the feed-screw, but also serves to counterbalance the weight of the recorder or reproducer, whichever happens to be in use.

The forward projection of the lever-arm 50 has a finger-piece, 60, Fig. II, by pressing upon which the nut 52 can be lifted out of engagement with the feed-screw and the carriage can be slid to any desired point. The reproducer D has also a finger-piece, 61, which overlaps the finger-piece 60. Thus, by pressing upon the part 61, the style of the reproducer is lifted from the record at the same time that nut 52 is disengaged from the feed-screw. This arrangement permits the carriage and parts connected with it to be moved back and forward—as, for instance, if it be desired to repeat any portion of the recorded speech or sound.

When the recorder or reproducer is in place, it is difficult to set its style accurately at any desired point. To obviate this difficulty the carriage M has a finger or pointer, 62, carried by a rod, 63. The point of the finger 62 approaches close to the surface of the tablet, and said point is in the same vertical plane transverse to the axis of the tablet as the style of the recorder or reproducer when in place in the carriage. Consequently, by means of the finger 62, the carriage can be set accurately at the desired point, and the recorder (or reproducer) then put in place.

The manner of constructing and mounting the carriage M, in addition to other advantages, prevents lateral vibration or wabbling, and one result of this is that the spiral lines of the record can be made closer together than was practicable heretofore. With the apparatus as described the relative speeds of the feed-screw and tablet-holder are so timed that the recorder traces one hundred and fifty-four lines to an inch on the tablet, thus largely increasing the capacity of the tablets.

The recorder C (see Figs. III, VI, VII, and VIII) is in most respects the same as in my Patent No. 341,288. It has the diaphragm 70, of mica, to the center of which is attached the cutting-style 71 and the adjustable bar or bridge-piece 72, having a smooth-surfaced enlargement, 73, at its middle for resting on the surface of the tablet and regulating the depth of the cut to be made by the style 71. It is attached to the carriage, as already explained, by placing the trunnions 57 in the sockets 56, from which it hangs downward and rests by gravity on the tablet 41.

The frame of the recorder consists of a metal ring, 74, with an internal shoulder or flange, 75, at its lower edge, upon which flange the mica diaphragm 70 is placed. Upon the diaphragm is a washer, 76, of yielding material—such as thick paper or card-board—and upon this is placed the metal disk 77, forming a thin air space or chamber in front of the diaphragm. These parts are held in place by the

top piece, 78, which is screwed into the ring 74. The top piece, 78, has a central cone, 79, terminating in a socket at its apex for the attachment of a speaking-tube or mouth-piece. The disk 77 has a series of openings or passages, 80 81, for the sonorous vibrations. These are shown as slots arranged in two concentric rings. These rings are disposed so as to affect equally as nearly as possible all parts of the diaphragm, the distance between the openings 80 and 81 being equal to the distance from the latter to the edge of the diaphragm and to the distance across the inner ring, 80.

The object is to divide the sound-passage, so that the sonorous vibrations will act simultaneously against different parts of the diaphragm, instead of being concentrated at its center, and thus cause it to vibrate uniformly over its entire surface. To carry out this principle it is important that all the sound-passages should be of the same length, which is secured by the construction of the top piece, 78. This is provided at its lower side with an annular shoulder, 82, which bears upon and clamps the edge of disk 77, and with a plate or disk, 83, which extends across it and forms an annular air-chamber in front of the disk 77. Disk 83 has shoulder 84 at its center, which bears upon the disk 77 between the first series of slots, 80, and the center. Disk 83 has a single series of openings or slots, 85 arranged in a ring midway between the series 80 and 81 of the disk 77. The openings 85 communicate with air-passages formed between the outer cone, 79, and an innerdeflecting-cone, 86. Thus it will be seen that the sonorous vibrations after reaching the apex of the cone 86 are propagated through a number of passages, all of the same length, but communicating with different points on the surface of the diaphragm. Upon the same principle the number of sound-passages may be multiplied by increasing the number of perforated disks interposed between the top piece and the diaphragm. The set-screws 87, passing through the frame 74, are for adjusting the position of the bridge-piece 72, and thus regulating normal depth of penetration of the style 71 into the wax coating of the tablet.

The reproducer D is best shown in Fig. V. It is hung in the carriage M in the same manner as the recorder, and the point of the rubbing-style rests by gravity upon the tablet 41, as heretofore.

The diaphragm 90 is inclosed in a case or chamber, 91, near the upper end of the reproducer-standard 92, or the end away from that which carries the style 93. The style is thus partially freed from the weight of the diaphragm and its mountings and rests more lightly on the tablet. The style 93 is an elbow or bell-crank lever pivoted at 970 in the end of the hollow standard 92, with its point projecting slightly beyond the end thereof. The style is made preferably of spring metal, so that while rigid in the direction of its normal movement it is flexible laterally, and is therefore not liable to slip out of the groove in the tablet.

The inner arm of the lever 93 is connected by a thread, 94, with the center of the diaphragm 90, the thread being inclosed in the hollow standard 92. The pin 95 acts as a stop to limit the extent to which the point of the style projects beyond its casing. The plate 96, which covers the rear of the diaphragm and to which the hollow standard 92 is attached, is perforated, so that the space behind the diaphragm is in communication with the outer air, whereby interference, which would to a certain extent result from reverberation, is prevented. All the working parts of the reproducer are thus inclosed and protected from damage that might result from careless handling. When the reproducer is in place, with the point of style 93 resting upon the record, the weight is sufficient to turn the style slightly on its pivot, pulling on the thread, and thus putting the diaphragm under tension. The tendency of the diaphragm to return to its normal position when pulled out by the motion of the style assists in causing the latter to follow closely the irregularities of the record and to descend fully into the depressions thereof.

One advantage of using a lever as the reproducing-style is that by making the inner arm shorter than the outer, as shown in the drawings, the motion of the diaphragm can be reduced, which, though it involves a slight loss in loudness, is found to produce a more than compensating gain in distinctness of enunciation.

The end of the flexible sound-conveying tube 12 fits over the upper end of a tube, 212, which is fixed in the frame of the reproducer D, and whose lower end, though not in contact, is in close proximity to the socket-piece 213, around the opening in the periphery of said piece for the passage of the sound-waves into the tube 12. The advantage of this construction is that the socket-piece may turn or vibrate on its pivots 214 without friction. It is found that there is no appreciable loss of loudness in the sounds reproduced, with a space of, say, two one-thousandths of an inch all around.

The apparatus can be started and stopped at will by means of clutch mechanism, which will now be described. (See Figs. II, III, IV, and IX.) The driving-pulley 25 is mounted not directly on the main shaft G, but on a stud, 98, fastened to upright or standard E, through which the shaft passes. The hub 97 of the pulley 25 has a serrated edge, 99, constituting one member of a clutch. The boss 103, which is fast on the main shaft G, has a corresponding serrated edge and constitutes the other member of the clutch. The main shaft G can be moved lengthwise in its bearings suffi-

ciently to engage and disengage the member of the clutch, and thereby stop or start the machine, as desired.

For greater convenience in operating the clutch a key-lever, 105, with two buttons, 106 and 107, is placed at the front of the upright F and fixed on the end of a rock-shaft, 108, having bearings in brackets 112, screwed to upright F. The rock-shaft at its rear end carries an arm, 109, whose point takes into a groove, 110, (see Fig. IX,) in the main shaft. By pressing on button 107 the main shaft is shifted to the right, the members of the clutch thrown into engagement, and the machine started. By pressing on button 106 the shaft is moved to the left, and the pulley 25 thereby disengaged from the shaft and allowed to revolve idly, the shaft coming to rest.

The cylindrical brush 115 is mounted on a spindle, 116, which has bearings in the swinging brackets 117, and carries on one end a pinion, 118, Fig. III. The brackets 117 hang loosely from shaft 36, so that, except when the brush is actually in use, it hangs clear of the other parts of the apparatus. A spiral spring, 119, encircles shaft 36 and bears at one end against a collar, 120, on said shaft, and at the other against bracket 117, and therefore tends to keep the brush in such position that the pinion 118 is out of the plane of gear 28. To use the brush, the operator swings it forward by grasping the stud 121, which is on the end of the brush-spindle 116, and at the same time pushes the brush to the left, thereby throwing the pinion 118 into engagement with gear 28, rapidly rotating the brush against the surface of the tablet, which is also in motion, and clearing it of all the cuttings of wax, which fall into the tray 124. When the brushing is complete, the operator releases it, and it falls by gravity to its normal position, the spring 119 throwing the whole frame to the right and moving pinion 118 out of the plane of rotation of gear 28. The brush 115 is inclosed for the greater part of its periphery in a casing, 123, which acts as a guard to prevent scattering of the shavings, and also partly as a frame to hold the parts together.

The screw 122, Fig. VI, passes through the stud 121. When the brush is raised, its point strikes the under side of upright F, thus limiting the motion of the brush in the direction of the tablet. The screw 122 can be adjusted to secure the proper pressure of the brush against the tablet.

The comb 126, Figs. III and V, extends across the machine below the tablet-holder, being mounted on tie-rod 27. Its teeth approach to within, say, one thirty-second ($\frac{1}{32}$) of an inch of the surface of the tablet 41. The teeth of this comb will catch the fine wax shaving cut by the recording-style and prevent its winding itself around the tablet.

A thin plate having a saw-tooth edge may be substituted for the comb with equally good effect and will be less expensive in construction.

The tablet 41 is preferably such as described in my application for Letters Patent No. 236,304, filed April 27, 1887.

It is obvious that modifications may be made without departing from the spirit of the invention, and that some of the improvements may, if desired, be used without others.

Having now fully described the said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. In an apparatus for recording and reproducing sounds, the combination, with the recorder, of a flexible tube or tubes provided with mouth-pieces and communicating with the space in front of the diaphragm of said recorder, and clamps or holders for attaching said tubes to the stand or table, substantially as described.

2. The combination, in a sound recording and reproducing apparatus, of the recorder, a tube leading to the diaphragm thereof, two flexible tubes connected with said first-named tube by a two-armed socket, and clamps or holders for said tubes detachably secured to the stand or table, substantially as described.

3. The combination of the recorder, a flexible tube or tubes communicating with the space in front of the diaphragm of said recorder, clamps or holders for attaching said tubes to the stand or table, and a bracket or holder for said recorder when not in use, substantially as described.

4. The combination, in a graphophone, of the frame, the main shaft supported in bearings therein, the tablet-holder removably supported in said frame, and gearing for rotating said tablet-holder from the main shaft, substantially as described.

5. The combination of the frame provided with forked supports, the spring-latches, and the tablet-holder having collars, one at each end, for insertion in said supports, said collars constituting the journal boxes or bearings for the tablet-holder, substantially as described.

6. The combination of the frame having forked supports, the cylindrical tablet-holder, the collars thereon adapted to rest in said supports, one of said collars being grooved, and the spring-latches for holding the tablet-holder in said supports, substantially as described.

7. The cylindrical tablet-holder increasing at one end to a larger diameter than the main portion of the holder, substantially as described.

8. In a graphophone, the combination, with the main shaft, of the tablet-holder, a gear-wheel connected therewith by a yielding connection, and gearing for driving said tablet-holder from said main shaft, substantially as described.

9. The combination of the main shaft, the

tablet-holder, a gear mounted on a collar loose on said holder, a spring connecting said collar and holder, and intermediate gearing between said shaft and holder, substantially as described.

10. The combination, with the recorder and reproducer, of the carriage having sockets for supporting the same, a stationary track or way on which said carriage slides, a feed-screw, and a nut carried by said carriage and engaging said screw, substantially as described.

11. The combination of the fixed tube having a longitudinal slot, the feed-screw within said tube, the carriage sliding on said tube, the arm attached to said carriage, and the nut carried by said arm and engaging said screw, substantially as described.

12. The combination of the fixed tube, the inclosed feed-screw, the carriage sliding on said tube, and the nut engaging said screw, and the pivoted arm carrying said nut, whereby the latter may be disengaged from said screw, substantially as described.

13. The combination of the fixed tube, the inclosed feed-screw, the carriage, the anti-friction wheels on said carriage in contact with the surface of said tube, the lever-arm, and the segment of a nut carried thereby and engaging said feed-screw, said wheels and nut, which constitute the bearing-points of the carriage, being arranged at approximately equal distances apart with respect to the axis thereof, substantially as described.

14. The combination, with the fixed tube, the carriage sliding thereon, and the feed-screw, of a lever-arm pivoted to said carriage, a nut on said arm, and a weight for holding said nut in engagement with said feed-screw, substantially as described.

15. The combination of the fixed tube, the carriage sliding thereon, the feed-screw, the nut engaging therewith, the lever carrying said nut and pivoted to said carriage, and the reproducer pivoted in said carriage and having a projection overlapping the end of said lever, so that by pressing on said projection the style is lifted from the record and the nut simultaneously disengaged from the feed-screw, substantially as described.

16. The combination, with the tablet-holder, of the sliding carriage for the recorder and reproducer, said carriage being provided with an indicator-finger having its point close to the surface of the tablet-holder, substantially as described.

17. In a sound recording or transmitting device, the combination, with a diaphragm responsive to sonorous vibrations, of a disk forming an air-chamber in front of said diaphragm, said disk being provided with a number of apertures arranged in series, dividing the diaphragm into rings of equal width, and said apertures being connected with a common mouth-piece, substantially as described.

18. The combination, with the diaphragm and a sound-conveying tube of a conical deflector having its apex in the axis of said tube, a casing or top piece, and a perforated disk or disks interposed between said top piece and the diaphragm, the perforations of said disks being so disposed as to constitute sound-passages all of the same length, but leading to different points on the surface of the diaphragm, substantially as described.

19. In a graphophone, the combination, with the tablet-holder and feed-screw, of the sliding carriage provided with sockets and a recorder having trunnions for resting in said sockets, whereby it can be readily placed on and removed from said carriage, substantially as described.

20. The combination, with the diaphragm of the reproducer, of the rubbing-style consisting of a lever having the rubbing-point formed on one arm and the other connected with said diaphragm, substantially as described.

21. In a reproducer adapted to rest by gravity on the record, the combination, with the standard, of a style supported in the free end thereof, a diaphragm mounted near the other end thereof, and a connection between the style and diaphragm, substantially as described.

22. The combination of the standard, the style consisting of a lever pivoted at one end thereof, the diaphragm supported near the other end, and a thread connecting one arm of said lever with the diaphragm, substantially as described.

23. The combination of the hollow standard, the diaphragm mounted therein, the style pivoted in the end thereof, and the thread inclosed in said hollow standard and connecting the style and diaphragm, substantially as described.

24. The combination, with the diaphragm, of the pivoted style, said style being connected with the diaphragm at a point nearer its fulcrum than the point that rests on the record, substantially as described.

25. In a graphophone, the combination, with the main shaft, the feed-screw and tablet-holder, and gearing for driving the same from said main shaft, of a clutch for starting and stopping said shaft at will, substantially as described.

26. In a graphophone, the combination, with the main shaft, the feed-screw and tablet-holder, and gearing for driving the same from said shaft, of a wheel or pulley for driving said shaft, mounted loosely thereon, and a clutch for engaging said shaft with said pulley or wheel when desired, substantially as described.

27. In a graphophone, the combination, with the main shaft, driving-pulley, tablet-holder, and carriage for the recorder or reproducer, operated from said main shaft, of the clutch mechanism for connecting and disconnecting said shaft and pulley and the key-lever carried by a rock-shaft connected at one end with said main shaft for operating said clutch mechanism, substantially as described.

28. The combination, with the tablet and tablet-holder and driving mechanism for the latter, of a rotating brush having a pinion on its spindle adapted to engage one of the gears of the machine when the brush is brought against the surface of the tablet, substantially as described.

29. The combination, with the tablet, tablet-holder, and driving mechanism, of the cylindrical brush having bearings in a swinging frame, so as to hang normally free of said tablet, but adapted to be brought into contact therewith and simultaneously thrown into gear with said driving mechanism, substantially as described.

30. The combination, with the tablet, tablet-holder, and driving mechanism, of the brush having bearings in a swinging frame hanging clear of the tablet, a pinion for engaging one of the gears, and a spring for moving the frame laterally to hold said pinion normally out of the plane of rotation of said gear, substantially as described.

31. The combination of the tablet-holder, the wax-coated tablet, the cylindrical brush carried in a swinging frame, and the tray beneath the brush and tablet, substantially as described.

32. The combination, with the tablet and tablet-holder, of the toothed plate or comb lengthwise of said tablet and having the points of its teeth in close proximity to the surface thereof, substantially as described.

33. The combination, with the pivoted reproducer having a suitable socket-piece provided with a sound-opening on its periphery, of a sound-conveying tube having its end in close proximity to the said socket-piece around the said opening, leaving a small space, so as to avoid friction, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TAINTER.

Witnesses:
ROBINSON WHITE,
O. J. HEDRICK.

UNITED STATES PATENT OFFICE.

EMILE BERLINER, OF WASHINGTON, DISTRICT OF COLUMBIA.

PROCESS OF PRODUCING RECORDS OF SOUND.

SPECIFICATION forming part of Letters Patent No. 382,790, dated May 15, 1888.

Application filed March 17, 1888. Serial No. 267,865. (No model.)

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Producing Records of Sounds, of which the following is a specification.

In a patent granted to me November 8, 1887, No. 372,786, I have described a method of recording and reproducing spoken words and other sounds; and in connection therewith and as a part thereof I have described a process of producing a record of sound-waves in solid resisting material by photo-engraving, the phonautographic record of such sound-waves having first been produced as an undulatory line of even depth in a traveling layer of non-resisting material.

My present invention is an improvement upon that described in my aforesaid patent; and it has for its object the production of a record of sound-waves in solid resisting material, principally metal, by the process of direct etching, whereby a solid unchangeable sound-record is obtained more cheaply and more readily, either upon a flat or upon a curved surface, without the delicate and intricate manipulations incidental to the process of photo-engraving. All this will more fully appear from the following detailed description, in which I shall freely refer to what is shown and described in my aforesaid patent as a part of the now common knowledge of mankind.

In accordance with the rules laid down in my patent, I produced a phonautographic record upon a traveling layer of lamp-black or other non-resisting material. Then this phonautographic record was transferred by photo-engraving upon metal, and the metallic record thus obtained was used for reproducing the recorded sounds.

In the course of my experiments I have found that in place of lamp-black other substances may be used as the non resisting medium for receiving the original phonautographic record, and I have also found that among these substances are such as will resist the chemical action of acids, but which offer no perceptible mechanical resistance to the movement of the recording-stylus. Upon this discovery my present invention is based, and it consists, broadly speaking, in producing a phonautographic record through a film of a suitable etching-ground deposited upon a traveling surface of resisting material, such as metal or glass, and then subjecting said surface to the action of a suitable etching agent, which attacks said surface at the places only where the etching-ground has been removed by the recording-stylus.

The etching-ground, which is to serve as the non-resisting medium for the phonautographic record, I prepare by dissolving beeswax, paraffine, or other like substance in a suitable solvent. By preference I use beeswax, and dissolve the same in benzine, so as to obtain a saturated solution. This solution is filtered, and care is taken to exclude as much as possible all dust, which is always present in the ambient air. The surface which is intended to receive this ground, which may be a flat disk or a cylinder of metal or glass, should be smoothly polished, and must be cleansed and dried. The wax solution is then poured over this surface, so as to cover the same at all points, and the solvent is then allowed to evaporate, which it does in one or two minutes. An exceedingly-fine film of wax then remains adhering to the surface of the metal or glass, and the consistency of this wax is such that it offers no perceptible mechanical resistance to the action of the recording-stylus, while at the same time it resists the chemical action of ordinary etching agents. In this respect the film of wax deposited from the solution is quite different from a layer of wax produced by melting. The latter has such consistency and adheres to the supporting-surface with such tenacity that considerable force must be used to penetrate the same and remove it from its support, while the wax film deposited in the manner described is so delicate that a camel's-hair brush will disturb it perceptibly.

Partly on account of the too great sensitiveness of a single film, and also as an additional protection against the action of the acids employed in the subsequent etching, I ordinarily, but not necessarily, apply a second coating of the solution, which, when dry, leaves a film of wax of such thickness as I have found to answer all requirements. A plate or cylinder thus prepared may be preserved in-

definitely, and is at all times in good condition to receive the phonautographic record. Such record is produced by moving the prepared surface under a stylus actuated by sound-waves to remove an undulatory line of the non-resisting film from its support, whereby the latter is laid bare along the said line, as is fully described in my patent above referred to, and as is now well understood by those skilled in the art. The plate or cylinder is then subjected to the action of a suitable etching agent, the nature of which varies according to the material of the support. For metals—such as zinc, copper, or brass—diluted nitric, hydrochloric, or other acid is used, while for glass or other like materials fluoric acid, or the fumes of the same, must be used. In either case I obtain upon the support within a few minutes an undulatory groove of even depth representing the sound-waves which acted upon the recording-stylus, and this groove is of sufficient depth to guide and control a reproducing-stylus in the manner set forth in my Patent No. 372,786.

I do not confine myself to any particular mode of etching, the ordinary process being followed in this respect. The same is true of the practice of rebiting, if a single exposure to the etching agent should prove to be insufficient to produce a groove of sufficient depth. From a record produced in the manner described any number of copies may be obtained by electro-deposition, especially if the original record is etched in metal. In that case, however, I have found it advisable to burnish the original record groove before the plate or cylinder is placed into the depositing-bath. This is a very simple process, and consists in holding and gently pressing a pointed burnishing-tool in the record-groove while the plate or cylinder is rotated. The tool is held in one hand while the plate or cylinder is rotated by the other. In this manner the burnishing-tool is guided through the record-groove from one end to the other, and the slightly-granular structure of the etched groove is thus polished without losing any of its essential characteristics. This process occupies only a very few minutes, and while it improves the galvano-plastic copy obtained from the original record, it is not absolutely essential. In place of a special burnishing-tool the reproducing-stylus may be used, the point of which is ordinarily of hard metal—such as iridium—so that the burnishing is effected by simply using the record once or twice for reproducing the recorded sounds in the ordinary manner.

It has been stated above that the dissolved and filtered wax or other ground should be carefully protected again t dust, which is always present in the surrounding air, and it is obvious that the same precaution should also be taken with respect to the plate or cylinder upon which the record is made; but experience has shown that it is almost impossible to guard effectually against the accession of fine filamentary particles of dust to and into the body of the tracing or etching ground. These dust particles are so fine that they cannot, as a rule, be detected by the most searching inspection of the prepared plate; but they become very conspicuous and a very serious source of annoyance when the record is made. As the recording-stylus passes through the wax or other ground, a fine undulatory line of the latter is removed, and the removed material drops away from the stylus as soon as removed, so that the point of the stylus always remains clean. This, however, is only the case when the ground is free of filamentary impurities; but if filaments of dust are embedded in the ground they adhere to the stylus, and, together with a coating of the ground, are dragged through newly-formed grooves, whereby the latter become uneven and receive ragged edges, which seriously impair the accuracy of the record. I have discovered an effective means for overcoming this difficulty, and it consists in simply moistening the record-surface with a fluid that slightly adheres to the ground and keeping it moist while the record is being made. I have found strong alcohol to be very effective for this purpose when wax is used as a tracing-ground, and it is used by pouring it over the ground just before the plate or cylinder is started to move under the recording-stylus. The alcohol evaporates rapidly, but not so rapidly as to disappear entirely before the record is finished, and this record now shows no trace of inequality, the lines being as sharp and well defined as if cut by a graver. The point of the stylus remains quite clean, and it seems as if the filamentary particles had disappeared. I have no definite theory by which to explain this surprising result. It is possible that the exceedingly-fine dust particles are forced against the walls of the grooves and are there held when the ground is in the peculiar state of dampness which it receives when alcohol is poured over the same. It is also possible that these particles of dust, being probably of organic matter, are dissolved by the alcohol, and it is also possible that both causes operate to keep the point of the stylus clean, so as to make a sharp and well-defined record; but whatever be the mode of action of the alcohol poured over the ground its effect is highly beneficial and its use constitutes one of my improvements.

The film of ground which I employ is so exceedingly thin that it is practically colorless and transparent. The record is for this reason almost invisible to the naked eye. In some cases, however, it is desirable to be able to inspect and scrutinize the record before it is exposed to the action of the etching agent, or to watch the progress of the record, and for this reason it is advisable to slightly color the ground before the record is made. I accomplish this by adding a small quantity of aniline-dye or other coloring-matter to the solu-

tion of wax or other ground. The record is then plainly visible as a pale line upon a dark ground.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. The method or process of producing a record of sound-waves in solid resisting material for reproduction of the recorded sounds, which consists in covering the surface of such material with a film of etching-ground that offers no perceptible mechanical resistance, then making a phonautographic record upon and through the etching-ground, and then exposing the record to the action of a suitable etching agent, substantially as described.

2. The method or process of producing a record of sound-waves in solid resisting material for reproduction of the recorded sounds, which consists in depositing upon the surface of such material a film of wax from a solution of the same in a suitable menstruum, then making a phonautographic record upon and through the wax film, and then exposing the record to the action of a suitable etching agent, substantially as described.

3. The method or process of producing a record of sound-waves in solid resisting material for reproduction of the recorded sounds, which consists in depositing upon the surface of such material a film of wax from a solution of the same in benzine, then making a phonautographic record upon and through the wax film, and then exposing the record to the action of a suitable etching agent, substantially as described.

4. The method or process of preparing solid surfaces for the reception of a phonautographic record, which consists in depositing upon said surfaces a film of tracing or etching ground and then moistening such film with an adhering fluid, substantially as described.

5. The method or process of preparing solid surfaces for the reception of a phonautographic record, which consists in depositing upon said surfaces a film of wax and then moistening the wax film with alcohol, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMILE BERLINER.

Witnesses:
JOSEPH LYONS,
S. WOLF.

437
(No Model.)

4 Sheets—Sheet 1

C. S. TAINTER.

GRAPHOPHONE.

No. 385,886. Patented July 10, 1888.

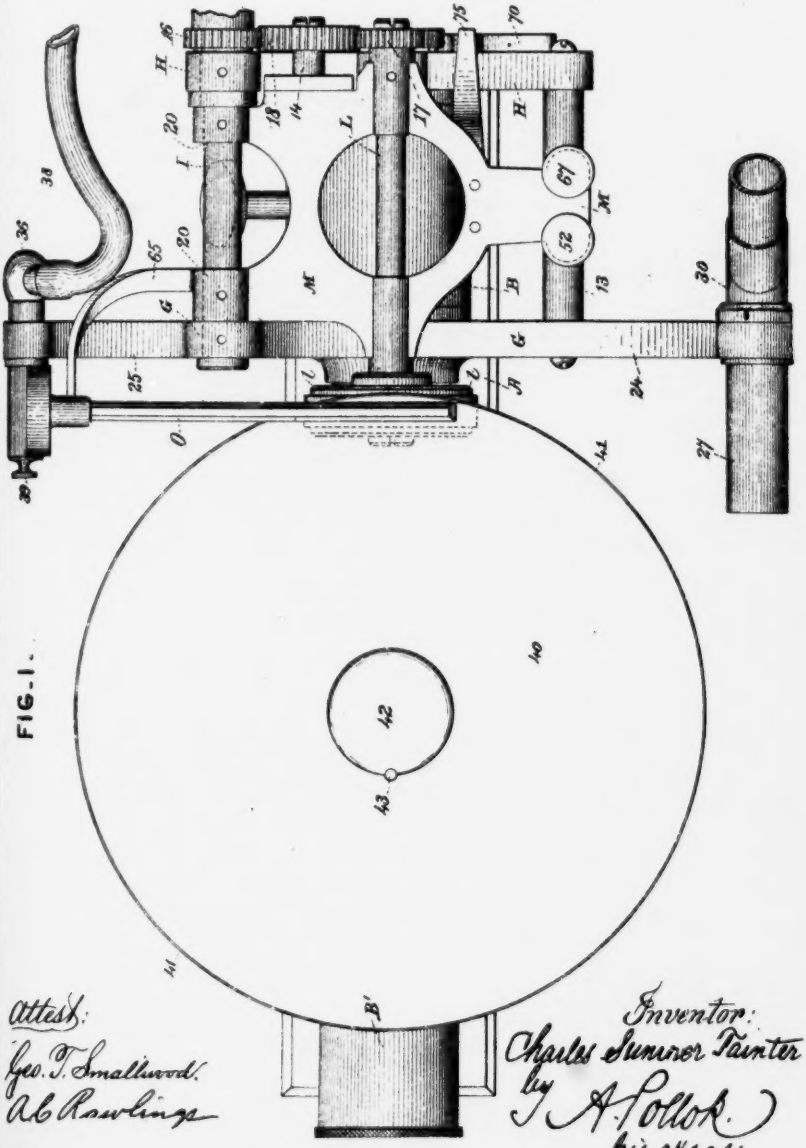


FIG. 1.

Attest:
Geo. T. Smallwood.
A. C. Rawlings

Inventor:
Charles Sumner Tainter
by A. Pollok.
his attorney.

428
(No Model.)

4 Sheets—Sheet 2.

C. S. TAINTER.

GRAPHOPHONE.

No. 385,886. Patented July 10, 1888.

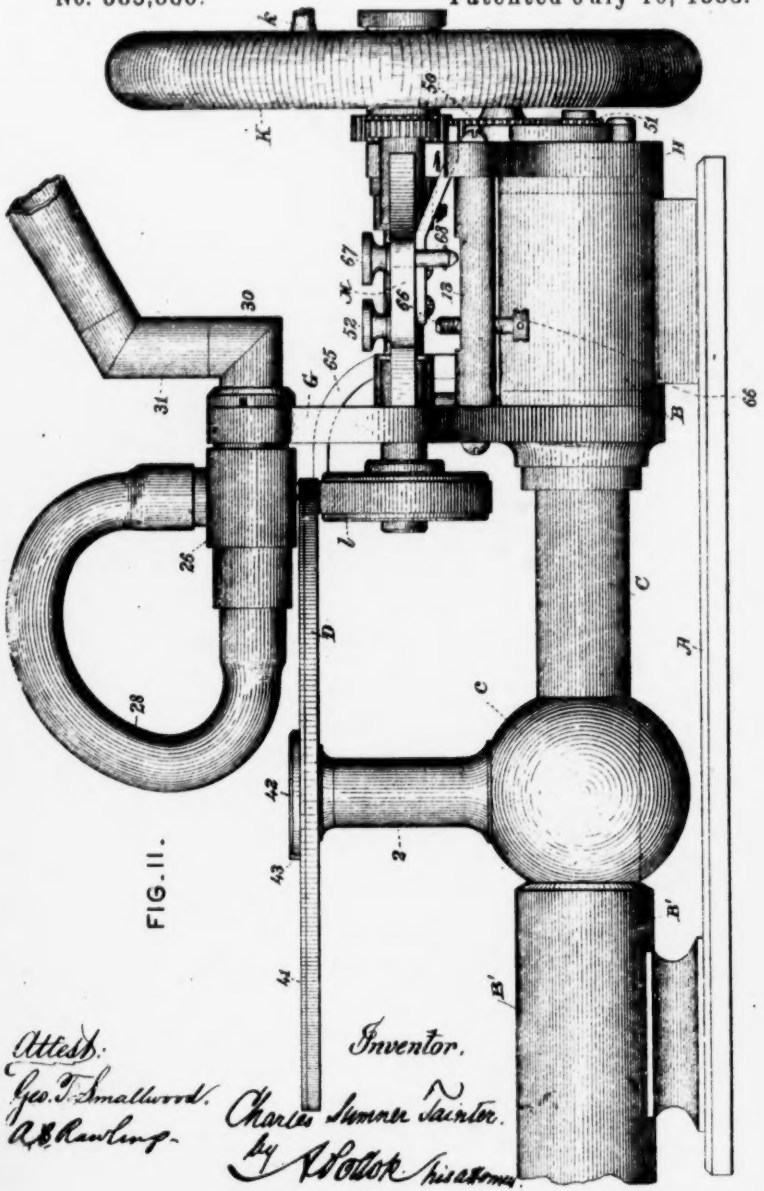


FIG. II.

Attest:
Geo. T. Smallwood.
A. B. Rawlings.

Inventor.
Charles Sumner Tainter.
by A. Pollok his attorney.

(No Model.) 4 Sheets—Sheet 3.

C. S. TAINTER.

GRAPHOPHONE.

No. 385,886. Patented July 10, 1888.

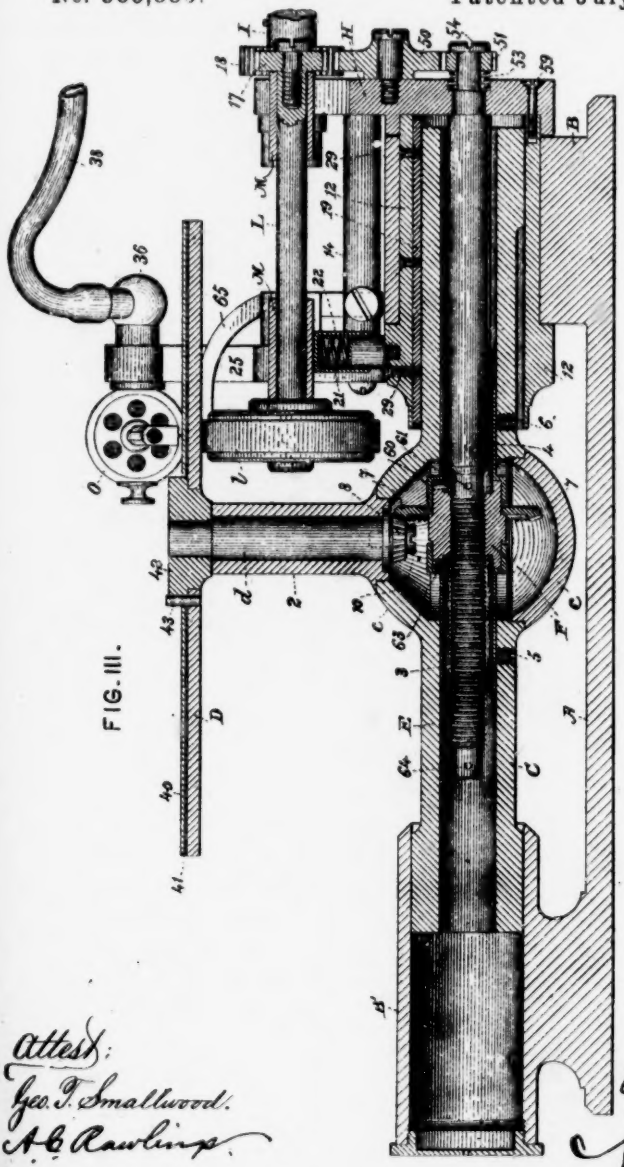


FIG. III.

Attest:
Geo. T. Smallwood.
A. C. Rawlings.

Inventor:
Charles S. Tainter
by
A. Bell K.
his attorney.

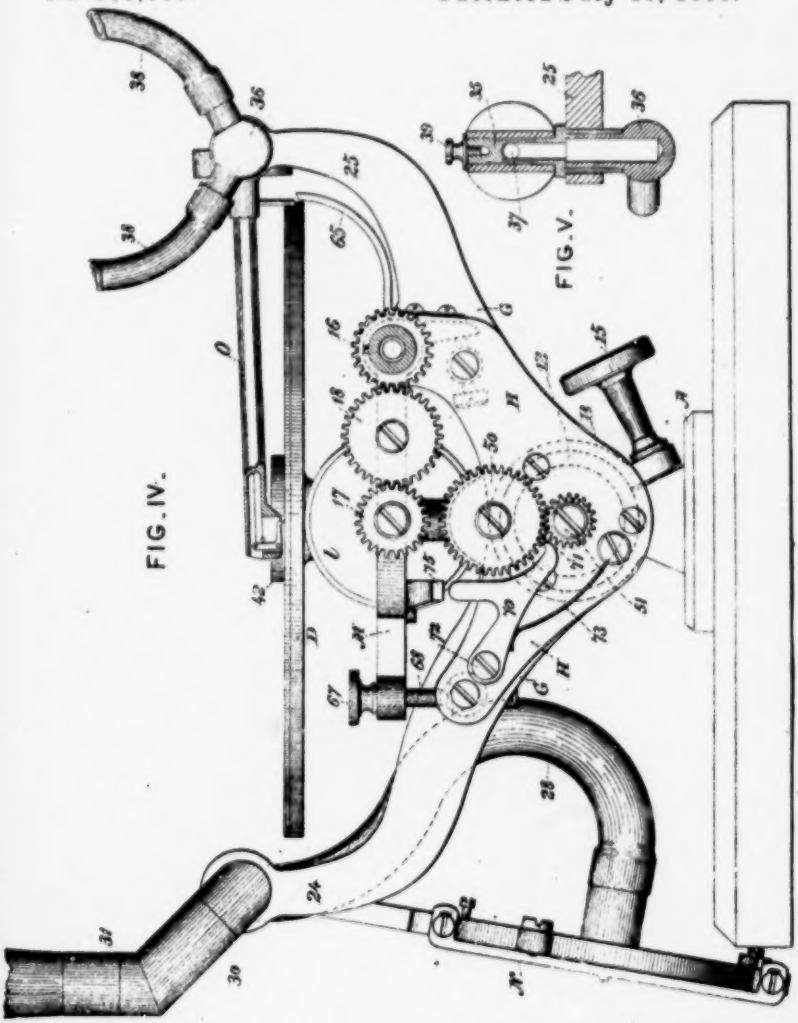
440
(No Model.)

4 Sheets—Sheet 4.

C. S. TAINTER.

GRAPHOPHONE.

No. 385,886. Patented July 10, 1888.



Attest:
Geo. T. Smallwood.
A. D. Rawlings.

Inventor:
Charles Sumner Tainter
by A. Pollok.
his attorney.

UNITED STATES PATENT OFFICE.

CHARLES SUMNER TAINTER OF WASHINGTON, DISTRICT OF COLUMBIA.

GRAPHOPHONE.

SPECIFICATION forming part of Letters Patent No. 383,836, dated July 10, 1888.

Application filed December 24, 1887. Serial No. 259,461. (No model.)

To all whom it may concern:

Be it known that I, CHARLES SUMNER TAINTER, of Washington, in the District of Columbia, have invented a new and useful Improvement in Graphophones, which improvement is fully set forth in the following specification.

This invention relates to apparatus for recording and reproducing speech, known as "graphophones," and has more particular reference to that class or type of graphophones in which the sound-record is made on a flat tablet. Such an apparatus is described in Letters Patent No. 341,214, granted May 4, 1886, to Chichester A. Bell and myself.

The invention has for its object, generally, to improve the construction of machines of this type and render them better available for practical use than they are in the forms known at present.

The tablet is preferably a thin layer of wax or a wax-like composition on a base of sheet metal or other suitable material. It rests on a disk-shaped tablet holder supported on a vertical shaft, said tablet-holder being driven by a friction-wheel making contact with its under surface. The tablet-holder and its shaft are so supported and connected with the driving mechanism that they are advanced slowly as the tablet rotates. The recorder therefore traces a spiral line upon the tablet. On a tablet of wax the lines of the spiral can be made very close together—say one one hundred and fiftieth ($\frac{1}{150}$) part of an inch or less apart. The longitudinal movement of the tablet and its holder is effected by means of a feed screw and nut, as will be hereinafter fully described. The recorder and reproducer are pivoted, respectively, on opposite sides of the tablet, so that when not in use either instrument can simply be turned on its pivot out of the way. This arrangement adds to the convenience in use of the machine, as it obviates the necessity of removing the recorder and substituting the reproducer, or vice versa.

When in operation, the point of the recording-style rests just above the friction-wheel that rotates the tablet, and the position of the reproducer on the opposite side of the tablet is such that when lowered into position its style will rest upon the same point on the surface of the tablet. As the longitudinal travel of the tablet-holder is very slow, it would require considerable time to set it back to the starting-point if the mere reversal of the main shaft were relied on for that operation. Consequently means have been provided whereby a rapid return of the tablet can be effected. To this end the arbor of the friction driving-wheel is supported in bearings on a frame swiveled on the main shaft and upheld by spring-pressure. By depressing this frame the friction-wheel is removed from contact with the tablet-holder, and at the same time the main shaft is thrown into gear with the feed screw (which in operation is stationary, the nut traveling with the tablet-holder) and imparts to said screw a rapid rotation, whereby the feed-nut, and with it the tablet-holder, is quickly moved back to the starting-point. Means are also provided whereby, when the starting-point is reached, the screw is automatically arrested, though the main shaft may continue to rotate; and by similar means the nut is arrested at the farther limit of its travel, which is of course determined by the diameter of the tablet designed to be used. A partial depression of the swiveled frame disconnects the friction-wheel and tablet-holder, arresting the latter without setting the reversing mechanism into operation. An arm carried by said swiveled frame lifts the reproducer from the tablet (should that instrument be in its operative position) when said frame is completely depressed.

The frame supporting all the operative parts of the apparatus is swiveled in bearings of the base or bed plate, so that it can be tilted to a greater or less angle with the horizontal, when its use may be thereby facilitated, and for the same purpose of adding to the convenience of the user the mouth-piece is connected with the recorder through a universal joint, so that said mouth-piece can be turned in any direction.

The invention comprises the new improvements above indicated as well as certain special features of construction and combinations and arrangement of parts, as hereinafter fully described.

In the accompanying drawings, which form a part of this specification, Figure I is a plan view of a machine constructed in accordance with the invention; Fig. II, a front elevation thereof; Fig. III, a vertical longitudinal section; Fig. IV, a side elevation with the fly-wheel removed, and Fig. V a partial vertical section through the support of the reproducer.

A is the base or bed plate, and B B' are tubular ways thereof in which the ends of the slide C are supported. Said slide has a bulb, *c*, intermediate between its ends, in the top of which is screwed the hollow standard 2, in which turns the shaft *d* of the tablet-holder D. The latter is in the form of a flat disk. Inside the tubular slide C is the feed-screw E, which in the operation of recording and reproducing is stationary. The feed-nut F, which engages said screw, is inclosed in the bulb *c*. It turns in bearings formed by the sleeves 3 4, which are connected to the slide C by screws 5 6. Feed-nut F carries a beveled gear, 7, which engages a beveled gear, 8, on the lower end of shaft *d*, the gear 8 being connected with said shaft by a screw, 10, tapped into the end thereof. When the tablet-holder rotates, it turns the nut F through gears 7 and 8, and the screw E being stationary the nut moves slowly lengthwise thereof, carrying with it the slide C and all the parts carried thereby.

G and H are standards or uprights. They are connected by a sleeve, 12, passing through tube B and adapted to turn therein. The sleeve 12 is in one piece with standard G, and is connected with standard H by screws 59 and tie-rods 13 and 14. Tube B is disconnected from the base A at the rear side, and is provided with a clamp screw, 15, whereby it can be tightened around the sleeve 12, and thus hold the frame and all the operative parts rigidly in one position. By loosening said screw the machine can be tilted forward and backward and clamped in the position that may be most convenient for the user. To prevent the slide C from tipping in its bearings, the end of said slide which enters the bearing B is grooved, and a spline, 19, which is attached to sleeve 12 by screws 29, enters said groove and prevents the slide C from turning independently of said sleeve 12.

The main shaft I has bearings in the uprights G H, and it carries a fly-wheel, K, and a crank-handle, *k*, for turning. Shaft L has bearings in a frame, M, and it is rotated from the main shaft through spur-gears 16 and 17 and intermediary 18, the latter being mounted on a stud tapped into said frame. At the left end of shaft L is a friction-wheel, *l*, which bears on the under side of tablet-holder D and turns the same on its shaft *d*.

The frame M is swiveled on the main shaft at 20 (see Fig. I) and can be lowered, so as to throw the friction-gear *l* out of contact with the tablet-holder D, and thus arrest the motion of the latter. The frame is normally held up by the pressure of spring 21, which bears at its lower end against upright G. The spring is surrounded by a tube, 22, which presses against frame M.

Upright G has arms 24 and 25 projecting toward the front and rear, respectively, and these constitute the supports for the recorder N and reproducer O.

The frame of recorder N has at its end a sleeve, 26, which slips on the tubular support 27, which is carried by the arm 24. Sleeve 26 is connected by a flexible tube, 28, with the sound-chamber of the recorder. On the right side of arm 24 is a bent tube, 30, which can turn in said arm, and another angular tube, 31, is connected with and can turn on the tube 30. The tubes 30 and 31 constitute a universal joint or socket for the mouth-piece of the recorder, which is adapted to be connected with the end of tube 31. The mouth-piece can thus be turned in any direction to suit the position of the user. It will be seen that a continuous sound-passage from mouth-piece to the diaphragm of the recorder is formed by the tubes 30, 31, and 27, sleeve 26, and flexible tube 28.

Heretofore flexible tubes have been employed to convey sound-waves to a diaphragm; but these require to be held to the lips by hand. In the use of a graphophone it is often desirable that the hands should be free for other purposes. By the construction described a rigid connection between the diaphragm and mouth-piece is provided, while at the same time the latter can be turned in any desired direction without disturbing the position of the style.

The recorder can be turned bodily on sleeve 27 as a center to bring its style into contact with the tablet, as shown in Fig. II, or to turn it out of the way, as in Fig. IV. When in its operative position, the point of the style rests on the tablet just above the friction-wheel *l*.

The reproducer O is mounted similarly to the recorder on a tubular support, 35, carried by arm 25, and is held in place by a screw, 39. A bifurcated socket-piece, 36, conveys the sonorous vibrations to suitable hearing-tubes, 38. Tubular support 35 has a perforation, 37, (see Fig. V,) through which it communicates with the hollow standard of the reproducer when the latter is in its operative position. When not in use and turned out of the way, this communication is cut off. The point of the reproducing-style, when in use, likewise rests just above the friction-wheel *l*. The relative positions of the recorder and reproducer are such that if the former be raised and the latter lowered into position its style will touch the same point on the tablet where that of the recorder rested.

The recording-tablet consists of a thin layer, 40, of wax or a wax-like composition upon a base or support, 41. (Shown as a disk.) It is preferred to make the base 41 of sheet metal, as other materials are more or less likely to warp. The edge of the disk 41 is turned up

all around, and the wax melted and poured into the dish thus formed. The center of the tablet is cut out to fit over the hub 42 of the tablet-holder D, and the latter has a projection, 43, which takes into a notch in the edge of the disk 41 and prevents the latter from slipping. While it is preferred to use a tablet of this description and to form the record by cutting or engraving therein, as described in the patent aforesaid, it is obvious that the machine is also adapted to operate in connection with a recorder that produces a record by indenting in a pliable substance or by removing part of a thin film of lamp-black, or in any other practical way.

The construction of the recorder and reproducer is or may be such as described in previous patents, and therefore needs no particular description here.

When the slide C has reached the farther limit of its motion, as shown in Fig. II, it can be quickly set back to the starting-point by reversing mechanism which will now be described. An intermediary, 50, turns on a stud carried by upright H and gears with a pinion, 51, on the end of feed-screw E. By depressing frame M, by pressing on button 52, the gear 17 is thrown into engagement with gear 50, and at the same time friction-wheel *l* is removed from tablet-holder D. Now, by turning the main shaft in the same direction as before the feed-screw E is driven at a high speed, and as the nut F is stationary, owing to the disconnection of wheel *l* and tablet-holder D, the said nut is rapidly moved to the right, carrying with it the slide C and all the parts supported thereby. Pinion 51 is connected with the feed-screw only by friction produced by a spring-washer, 53, pressing it against screw 54. This is sufficient to insure rotation of the feed-screw; but when the nut F reaches the limit of its return movement a pin, 60, carried thereby strikes a pin, 61, on said screw and stops the rotation of the latter, the pinion 50 now turning against the pressure of washer 53 independently of the screw. When the nut F reaches the limit of its travel to the left, a pin, 63, strikes a pin, 64, on the feed-screw E, and the latter then turns with the former. The slide C is thus automatically arrested at both limits of its travel.

Frame M has a backwardly and upwardly extending arm, 65, the end of which approaches close to the under side of the reproducer. If the latter be in its operative position when the frame M is depressed to operate the reversing mechanism, it will be lifted by arm 65 clear of the record. Frame M is, as shown, provided with two buttons, 52 and 67, for pressing with the finger. If it be desired simply to stop the tablet without setting the reversing mechanism into operation, button 67 is used. By pressing on button 52 the frame is completely depressed. Button 67 is on the end of a shank, 68, which passes loosely through a hole in the frame M, and its motion is limited by contact with the tie-rod 13. By pressing button 52, however, the frame continues to descend after the end of shank 68 strikes the tie-rod, because said shank is not connected rigidly with the frame, but passes loosely through the same, as already stated. A stop-screw, 66, passes through tie-rod 13 and limits the movement of frame M when pressed down by button 52.

As has been stated, in the operation of recording and reproducing the feed-screw is stationary; but unless positively held it would be liable to be turned in its bearings by the friction of the feed-nut F. To prevent this a locking-lever, 70, is pivoted at 72 to the upright H, (see Fig. IV,) and has a point, 71, which engages the teeth of wheel 50 and holds it stationary. The locking device 70 is held in this position by a spring, 73. Since pinion 51 on the feed-screw E is engaged by wheel 50, the feed-screw is thus prevented from rotating. When, however, frame M is depressed to operate the reversing mechanism, as arm, 75, carried by said frame strikes the pivoted locking device 70 and releases the gear 50, so that when the latter is engaged by gear 17 it is free to rotate.

In operation, the slide being at the right-hand limit of its motion, as in Fig. III, the recorder is lowered until it rests upon the wax surface of the tablet. The main shaft being rotated, tablet-holder D is driven by friction-wheel *l*, and in turn rotates the feed-nut F, which is thus caused to advance slowly lengthwise of feed-screw E, which is held stationary by the engagement of locking-lever 70 with gear 50. The point of the recorder therefore traces a volute or spiral line on the surface of the tablet. As the tablet-holder D continues to advance, the point of contact with it of the friction-wheel *l* gradually approaches its outer edge. Consequently the tablet-holder revolves more and more slowly; but the surface-speed under the point of the recorder (or reproducer) is uniform. This construction and its advantages are fully set forth in the patent hereinbefore referred to.

It is obvious that modifications may be made in details of construction, and that parts of the invention may be used without the whole without in either case departing from the spirit of the invention.

The flat tablet herein shown and described forms the subject-matter of my application No. 269,465, filed April 3, 1888, and is not claimed herein.

Having now fully described my said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. In a graphophone, the combination, with the tablet-holder and means for rotating and advancing the same longitudinally, of the recorder and reproducer, each pivoted on suitable supports and adapted to be turned into and out of operative position, substantially as described.

2. The combination of the slide, the tablet-holder mounted on a shaft having bearings in said slide, means for rotating said shaft and advancing said slide, a recorder pivoted on one side of the tablet-holder, and a reproducer pivoted on the opposite side thereof, their relative positions being such that the recording and reproducing styles touch the tablet at the same point, substantially as described.

3. In a graphophone, the combination, with the rotatory tablet-holder, the friction-wheel for driving the same, and means for advancing said tablet-holder longitudinally, of a recorder pivoted to the frame and a reproducer also pivoted to the frame, said recorder and reproducer being so disposed that when either is in operative position its style will rest on the tablet just above said friction-wheel, substantially as described.

4. In a graphophone, the combination, with the rotatory tablet-holder, of the friction-wheel for driving the same and a tilting frame in which the arbor of said friction-wheel is journaled, substantially as and for the purpose described.

5. In a graphophone, the combination, with the tablet-holder and means for rotating the same, of the feed-nut, the feed screw, and means for disconnecting said nut from the driving-shaft and simultaneously connecting said screw therewith, substantially as described.

6. In a graphophone, the combination of the slide, the rotatory tablet-holder carried thereby, the feed-screw normally stationary, the feed-nut connected to be advanced lengthwise of said screw by the rotation of said holder, and means for disconnecting said tablet-holder from the driving-shaft and connecting the feed-screw therewith so as to reverse the movement of said nut, substantially as described.

7. The combination of the slide, the tablet-holder, the friction-wheel for rotating the same, the tilting frame in which the arbor of said friction-wheel is journaled, gearing for driving the latter from the main shaft, the feed-screw normally stationary, the feed-nut carried by said slide and connected by gearing with said tablet-holder, and gearing for connecting said feed-screw with said main shaft when said frame is moved to disengage the tablet-holder and friction-wheel, substantially as described.

8. In a graphophone, the combination of the slide, the tablet-holder carried thereby, the feed-nut and feed-screw, the driving mechanism, and stop-pins on said feed nut and screw, whereby the slide is automatically arrested at the limits of its travel, substantially as described.

9. The combination of the slide, the rotatory tablet-holder, the reproducer, the feed nut and screw, mechanism for reversing the movement of said slide, the tilting frame for operating said reversing mechanism, and an arm carried by said slide and adapted to lift the reproducer from the tablet when said frame is tilted, substantially as described.

10. The combination of the slide, the tablet-holder, the feed-screw, the feed-nut connected by gearing with said tablet-holder, a pinion loosely mounted on said feed-screw, a spring-washer for effecting a frictional connection between said screw and pinion, and stop-pins on said nut and screw by engagement of which the screw and nut are connected together, substantially as described.

11. The combination of the slide, the tablet-holder, the feed-screw supported in bearings in the frame, the feed nut connected by gearing with said tablet-holder, and the locking device for holding said feed-screw stationary, substantially as described.

12. The combination of the slide, the tablet-holder, the feed screw supported in bearings, the feed-nut rotated from said tablet-holder, the locking device for holding said screw stationary, the tilting frame for disengaging said tablet-holder from the main shaft and connecting the feed screw therewith, and an arm or projection adapted on the depression of said frame to disengage said locking device, substantially as described.

13. The combination of the rotatory tablet-holder, the feed screw and nut for moving said tablet-holder longitudinally, a tilting frame, a friction-wheel on an arbor having bearings in said frame for rotating said tablet-holder, and reversing-gears adapted to be connected with the main shaft by said frame, all constructed and arranged as set forth, so that the frame can be tilted to disconnect said friction-wheel and tablet-holder without connecting said reversing-gear and main shaft, substantially as described.

14. The combination of the tablet-holder, the feed-nut connected by gearing with said tablet-holder, the feed-screw normally stationary, the tilting frame, the friction-gear for rotating said tablet-holder, carried on an arbor having bearings in said frame, reversing-gears adapted to connect said screw and the main shaft when said frame is tilted, a button on said frame for tilting the same, and a second button on a shank passing loosely through said frame and having its end in close proximity to a fixed part of the apparatus, so that on pressing the latter button the frame will move only far enough to disengage the tablet-holder and friction-gear without connecting in the reversing mechanism, substantially as described.

15. The combination, with the frame and recorder, of the rigid sound-conveying tube having several bent or angular sections jointed together, constituting in effect a universal joint, whereby the position of a mouth-piece attached to said tube can be shifted vertically or laterally without disturbing the position of the style, substantially as described.

16. In a graphophone, the combination

with a supporting-frame, and the tablet-holder, recorder, and operative mechanism carried by said frame, of the base or bed plate to which said frame is pivotally connected, so that the entire apparatus can be tipped to any angle, and means, as specified, for holding the apparatus at the angle to which it may be adjusted, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TAINTER.

Witnesses:
PHILIP MAURO,
C. E. HADLEY.

446
(No Model.)

2 Sheets—Sheet 1.

W. SUESS

GRAMOPHONE.

No. 427,279. Patented May 6, 1890.

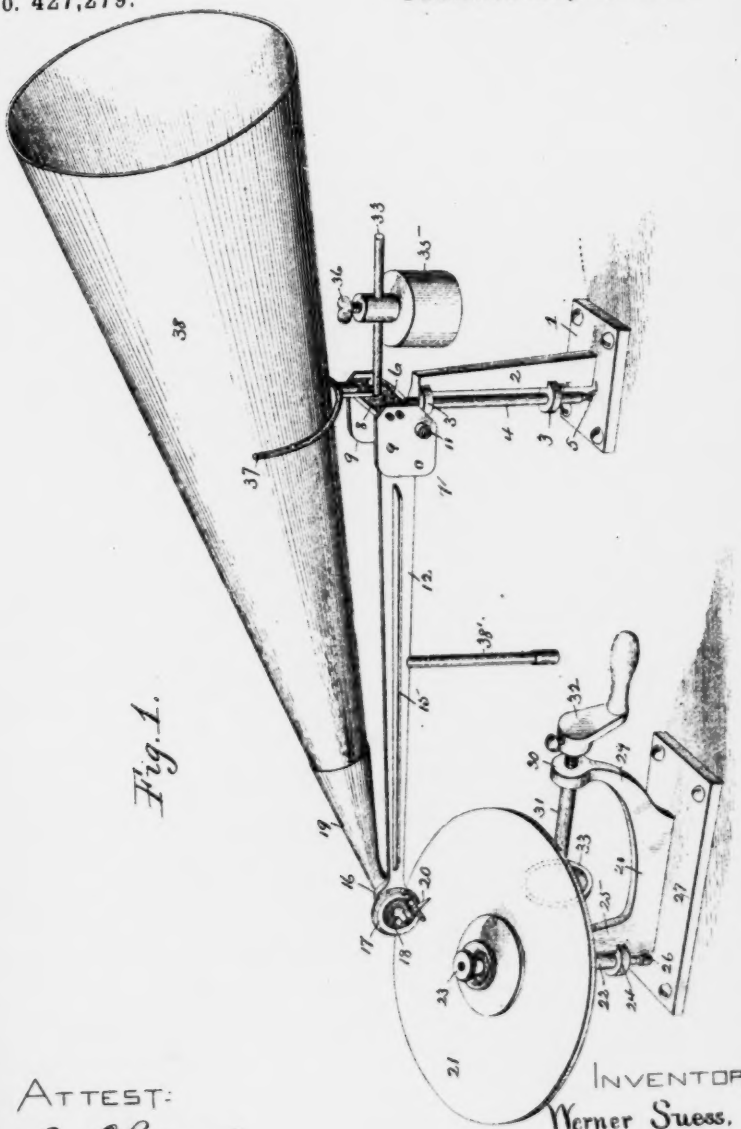


Fig. 1.

ATTEST:

Roy C. Bowen

F. T. Chapman

INVENTOR:

Werner Suess,

By Joseph Lyon,

his Attorney.

447

(No Model.) 2 Sheets—Sheet 2.

W. SUESS.

GRAMOPHONE.

No. 427,279 Patented May 6, 1890.

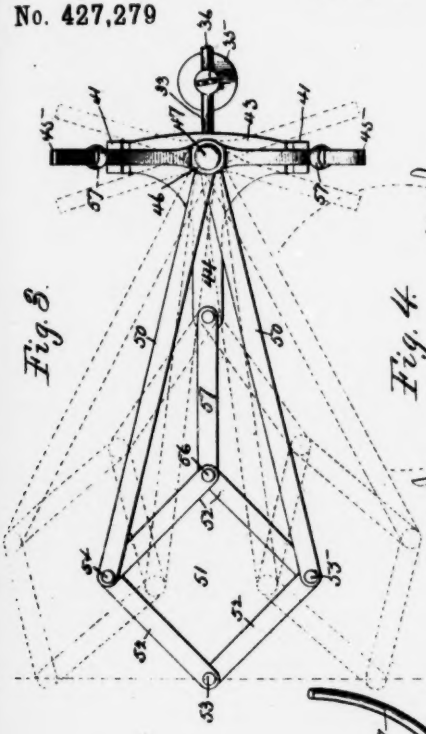


Fig. 3.

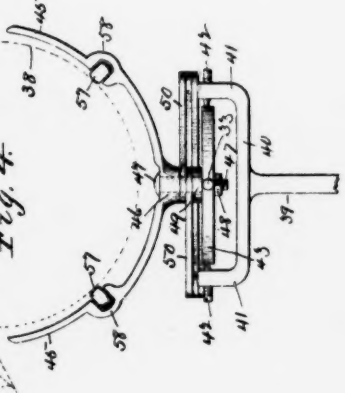


Fig. 4.

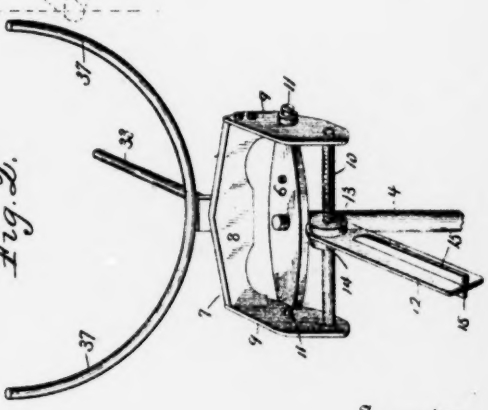


Fig. 2.

Witnesses

Percy C. Brown

F. F. Chapman

Inventor.

Werner Suess.

By his Attorney

Joseph Lyons

UNITED STATES PATENT OFFICE.

WERNER SUESS, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO EMILE BERLINER, OF SAME PLACE.

GRAMOPHONE.

SPECIFICATION forming part of Letters Patent No. 427,979, dated May 6, 1890.

Application filed August 6, 1888. Serial No. 319,866. (No model.)

To all whom it may concern:

Be it known that I, WERNER SUESS, a citizen of the United States, and a resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Gramophones, of which the following is a specification.

My invention has reference to improvements in the reproducing apparatus adapted for use in the method of recording and reproducing sounds set forth in Letters Patents No. 372,786, of November 8, 1887, and No. 382,790, of May 15, 1888, both granted to Emile Berliner. The whole apparatus used for the practice of the said method has been called the "gramophone," and in this class of sound recording and reproducing apparatus the record is ordinarily produced on the face of a rotating disk as a volute band consisting of a sinuous or undulating groove of even depth. In the production of this record a recording-stylus is made to travel over the face of the rotating disk from the outer circumference toward the center in a straight radial path. The reproduction of the recorded sounds is effected by giving to a reproducing-stylus vibratory movement by and in accordance with the sinuosities of the record-groove, and, these vibratory movements being transmitted to a diaphragm, vibrations of the latter give rise to sounds which are copies of the sounds originally uttered against the recording apparatus.

With the view of intensifying the sound emitted by the reproducer, and more especially of directing the same to the listener or listeners, I r a funnel-shaped tube, on the contracted end of which the reproducing stylus and diaphragm are mounted, while the open flaring end of the tube is directed toward the listener or listeners. This flaring sound-conveyer, thus becoming an integral part of the reproducer, must have all the mass movements of the stylus and diaphragm, and being of considerable weight it must be so supported and balanced that the recording-stylus will bear with light but sufficient pressure upon the record-tablet. The best results are obtained if the reproducing-stylus is made to travel in a straight radial line across the face of the record-tablet, substantially in the manner in which the recording-stylus has traveled in producing the record. The main features of my present invention therefore have reference to the means for supporting and counterbalancing the sound-conveying tube with its attached diaphragm and reproducing-stylus and for making the path of the stylus across the face of the record-disk as nearly as practicable a straight radial line. The stylus engaging with its point the record-groove is controlled by the walls of the latter, and, as will be hereinafter more fully shown, I rely upon this control of the stylus by the walls of the record-groove for the movement of the stylus across the face of the disk, there being no positive feeding mechanism for thus moving the stylus. All this will more fully appear from the following detailed description, in which reference is made to the accompanying drawings, which form a part of this specification, and in which I have shown, in—

Figure 1, a perspective view of one form of reproducer, shown in the supporting frame with a sound-conveying tube, with the diaphragm and stylus in operative relation to the record-disk. Fig. 2 is a perspective view of the pivotal bearing of the frame with parts removed and broken away. Fig. 3 is a plan view of another form of supporting-frame for the reproducer, by which the stylus is caused to travel in a straight line across the record-tablet. Fig. 4 is an end view of the same with the counter-weight removed.

Like numerals of reference indicate like parts all throughout the drawings.

Referring now to Fig. 1, there is shown a base-plate 1, which may be secured by screws or otherwise to any suitable support—such, for instance, as a table. Erected on this base-plate is a standard 2, on one edge of which are laterally-projecting eyes 3, forming guides in which turns a vertical shaft or pivot 4. This shaft is stepped at the lower end in a bearing 5 in the base-plate, and at the upper end has secured to or formed on it a head 6, which, as shown more clearly in Fig. 2, consists of a flat plate, to the center of which the shaft 4 is attached. This head 6 serves

as a support for a frame 7, consisting of an end piece 8, two parallel side pieces 9, secured at one end to the end piece by screws, as shown, or otherwise, and a rod 10, joining the other ends of the side pieces 9. Mounted in the side pieces 9 are pointed screws 11, projecting through nuts therein and entering oppositely-arranged seats (not shown) in the ends of the head 6, and forming a pivotal bearing for the frame 7, around which it may turn in a vertical plane at right angles to the axis of the shaft 4. It will now be understood that the frame 7 may be moved in any direction, the shaft 4 and pivot-screws 11 constituting a universal joint for the same. The rod 10 carries one end of an arm 12, secured rigidly thereon by a jam-nut 13, which clamps the said arm firmly against a flange 14 on the rod, which latter is screw-threaded, as shown, for the reception of the nut 13. The arm 12 is stiffened by longitudinal side ribs 15 and terminates at the free end in a head 16, on one side of which is secured a diaphragm-holder 17, carrying a diaphragm 18, and on the other side of the head there is secured a flaring socket 19, communicating at its reduced end with a chamber (not shown) at the rear of the diaphragm.

Attached to the diaphragm is a stylus 20, mounted for lateral vibration, and, together with the said diaphragm, forming a sound-reproducer. The construction of the stylus and the mounting therefor form no part of the present invention, and are therefore not specifically described herein. The point of the stylus rests normally in the record-groove produced on the face of a disk-tablet 21, which is mounted for rotation upon a disk carried by a vertical shaft 22, similar to the shaft 4, before described. As shown in Fig. 1, the shaft 22 has at its upper end a thumb-nut 23, by means of which the tablet is clamped thereon, and the said shaft is passed through eyes 24 (one only being shown) on a standard 25 and stepped in a bearing 26 in a base-plate 27, on which the standard is erected. The lower end of the standard is extended laterally on the plate 27, as shown at 28, and terminates in an upturned end 29, carrying at its upper end and below the level of the tablet a bearing 30 for a horizontal shaft 31, which latter is provided with a crank 32 at the outer end and a friction-wheel 33 at the inner end, which wheel engages the under side of the tablet-supporting disk, which is not visible in the drawings. It will now be understood that when the shaft 31 is rotated by means of the crank 32 the friction-wheel 33, engaging the tablet-support, will cause the latter to rotate and carry successive portions of the record under the stylus to reproduce the sounds in a manner described in the aforesaid Letters Patent.

The mechanism for supporting and rotating the tablet may be of any suitable construction and entirely different from that shown, such construction being by no means an essential feature of my invention.

Secured to the end piece 8 of the frame 7 is a rod or arm 33', extending in a direction opposite to that of the arm 12, and carries a weight or block 35. This weight may be adjusted upon rod 33' and clamped in any desired position on a thumb-screw 36.

Attached to a short stem erected on the end piece 8 and over the shaft 4 is a semicircular bracket 37, on which rests the funnel-shaped sound-conveyer 38, the smaller end of which enters the socket 19. It will be readily understood that the sound-conveyer supported in the manner described, together with the diaphragm and stylus carried in the mounting attached to the arm 12, may be moved laterally around the axis of the pivot-shaft 4 and vertically around the axis of the frame 7. By reason of these two movements the stylus may be made to approach toward or recede from the axis of the rotating tablet, and in this manner traverse every portion of the surface of the said tablet, or it may be swung aside and entirely removed therefrom.

The operation of an apparatus so constructed is as follows: The tablet 21, containing a sound-record in the form of a convolute, sinuous, or wavy groove produced in the manner set forth in my aforesaid Letters Patents, is mounted on the supporting-disk carried by the shaft or spindle 22. The weight 35 is adjusted to nearly counterbalance the arm 12 and parts carried thereby, so that the stylus rests lightly, but with sufficient pressure, on the tablet with its point in the record-groove. The tablet is now rotated and the sinuous groove thereon vibrates the stylus, which in turn vibrates the diaphragm in accordance therewith, and thus produces sound-waves, which latter are directed toward the listener by the sound-conveyer 38. As the rotation of the tablet is continued the convolutions of the record-groove will cause the stylus to be slowly drawn across the tablet, turning the entire support of the reproducing apparatus on its pivot-bearing, the said stylus moving along a slightly-curved path over the said tablet. When placing a tablet in position, or on removing it therefrom, it is necessary to move the reproducer out of operative relation thereto, and for this purpose the supporting-frame is swung on the horizontal and vertical pivots to some position away from the tablet, when it may be lowered until a leg 38', which depends from the arm 12, rests upon the table on which the apparatus is secured. It will be understood that the counter-weight may be adjusted to cause the stylus to bear with any desired degree of pressure on the tablet.

Referring now more particularly to Figs. 3 and 4, there is shown a standard or post 39, which is fixed to a table or other support and terminates at the upper end in a yoke 40, having two upturned parallel ends 41, each carrying an inwardly-projecting pointed screw 42, extending through a suitable nut formed therein. The pointed ends of these screws enter suitable seats on opposite sides of a

plate 43 and constitute a horizontal pivotal bearing on which the said plate may be rocked. The plate 43 has an arm 44 formed on it and extending centrally from one side at right angles to its axis, and it also has another arm 33', similar to that shown in Figs. 1 and 2, extending in a direction opposite to the arm 44, being on the other side of the axis of the plate. The arm 33' carries a sliding weight 35, similar in construction to that before described, and in a like manner serving as a counter-weight. Above the center of the plate 43 there is a semicircular bracket consisting of two curved branching arms 45, rising from a block 46. Through this block there is a perforation for a pivot-bolt 47, which extends downwardly through the plate 43 and there receives a nut 48, by means of which the bolt is secured to the said plate, and the head of the bolt engages the upper face of the said block 46. This bolt 47 also passes through a washer 49, resting directly on the upper surface of the plate 43, and through eyes formed in the ends of links 50, the said ends being interposed between the lower end of the block 46 and the washer 49. Thus it will be seen that the bolt forms a vertical pivot around which the bracket 45 46 and the links 50 may move, and also secures them to the said plate. The outer ends of the links 50 are pivoted to opposing corners of an articulated frame 51, composed of links 52, of equal length, connected together at the ends by pivot-pins 53, 54, 55, and 56, respectively, the pins 54 and 55 also connecting the links 50 to the frame at the points before mentioned. The pin 56 also pivotally connects one end of a link 57 to the corresponding corner of the frame 51, the other end of the said link being pivoted to the outer end of the arm 44.

The frame 51, together with the links 50 and 57, constitutes a well-known mechanical movement by which a curvilinear movement is converted into a rectilinear movement, provided the various links have the proper relative lengths, which is supposed to be the case in this instance, and therefore no detailed description of the operation thereof is deemed necessary.

In the apparatus shown in Figs. 3 and 4 the arm 12 is replaced by the link movement or system, and in this case the stylus and diaphragm will be mounted on the outer or free end of the said link system—namely, at 53—and the sound-conveyer 38 (indicated by dotted lines in Fig. 4) will rest on friction-rollers 57, mounted in bearings formed in cut-away or recessed portions 58 of the bracket-arms 45. In the operation of this apparatus the counter-weight 35 is adjusted in the manner before described and the entire reproducer mechanism is moved to a position in which the stylus rests on the tablet at the beginning of the record to be produced. Such position is indicated in Fig. 3 by the upper series of dotted lines, from which it will be seen that the frame 51 is of greater length than breadth. As the record-tablet is rotated the volute record-groove acting on the stylus slowly draws it across the face of the tablet, as before explained, and turns the entire reproducing apparatus on its vertical axis or pivot 47. As the apparatus approaches the position coinciding with the vertical plane of the arm 44 of the plate 43 the link 57, moving through an arc of shorter radius than that of the links 50, tends to force the frame 51 outward, which tendency is resisted by the said links 50, and the consequent action of these two opposing forces is to shorten the length and increase the breadth of the said frame 51 until it assumes the square form shown in full lines, Fig. 3. As the movement of the stylus is continued beyond the central plane of the arm 44 the frame 51 will be again lengthened, as indicated by the lower series of dotted lines. It will be understood that the length of the frame 51 decreases as the latter approaches a central position and increases as it recedes therefrom, and in accordance with this change of shape of the said frame its outer end (and the stylus thereon) will be carried to a constantly-increasing distance from the pivot or axis of the apparatus, and the resultant of this constant longitudinal movement of the outer end of the frame while the apparatus moves in an arc around its pivot is to move the said end in a straight line. When the reproducer-stylus is moved over the record-tablet in the manner stated, its path will coincide with the radius of such tablet, and the point of the said reproducer-stylus will be at all times in the same relation to the record-grooves as was the recorder-stylus in producing such record. In this operation the sound-conveyer must participate in the movement of the stylus toward and from the pivot 47, and it will therefore slide upon the arms 45 of the supporting-bracket, and with a view of reducing the friction the rollers 57 are provided.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. In an apparatus for reproducing sounds from a record-tablet, the combination, with a reproducer mechanism consisting of a sound-conveying tube and a diaphragm and stylus mounted at one end of the tube, of a freely-swinging supporting-frame for the said reproducer mechanism and a weight adjustable on the said frame to counterbalance the reproducer mechanism, substantially as described.

2. In an apparatus for reproducing sounds from a record-tablet, the combination, with a reproducer mechanism consisting of a sound-conveyer and a diaphragm and stylus mounted at one end thereof, of a supporting-frame for the said reproducer, loosely pivoted to swing freely both laterally and vertically, and

an adjustable counter-weight on the said frame for determining the pressure of the stylus on the record-tablet, substantially as described.

3. In an apparatus for reproducing sounds from a record-tablet, the combination, with a reproducer mechanism consisting of a sound-conveyer and a diaphragm and stylus at one end of the said conveyer, of a counterweighted pivoted frame for supporting the reproducer mechanism and provided with a system of laterally-movable pivoted links connected at one end to the said reproducer mechanism and at the other to a portion of the supporting-frame fixed against lateral movement, substantially as described.

4. In an apparatus for reproducing sounds from a record-tablet, the combination, with a reproducer mechanism consisting of a sound-conveyer and a diaphragm and stylus at one end of the said conveyer, of a system of links supporting the stylus end of the reproducer and proportioned and arranged, as described, for moving the stylus in a straight path across the record-surface, substantially as described.

5. In an apparatus for reproducing sounds from a record-tablet, the combination, with a reproducer mechanism consisting of a sound-conveyer and a diaphragm and stylus at one end of the said conveyer, of a system of links supporting the stylus end of the reproducer and constructed, as described, for moving the stylus in a straight path across the record-surface, and a pivoted bracket on which the sound-conveyer rests, provided with anti-friction rollers on which the said conveyer travels longitudinally to participate in the movement of the stylus end of the reproducer, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WERNER SUESS.

Witnesses:
F. T. CHAPMAN,
J. B. MACAULEY.

452
(No Model.)

4 Sheets—Sheet 1.

E. BERLINER.

GRAMOPHONE.

No. 534,543. Patented Feb. 19, 1895.

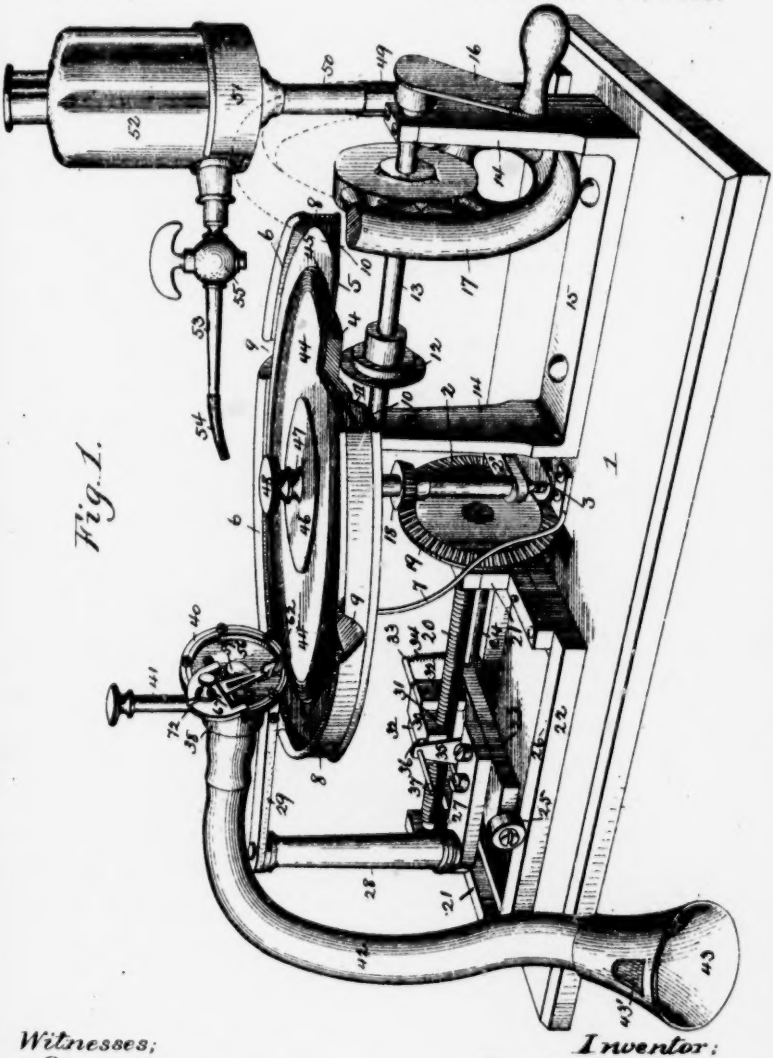


Fig. 1.

Witnesses;
Roy C. Bowen
F. T. Chapman

Inventor;
Emile Berliner,
By Joseph Lyon.
Attorney.

453
(No Model.)

4 Sheets—Sheet 2.

E. BERLINER.

GRAMOPHONE.

No. 534,543. Patented Feb. 19, 1895.

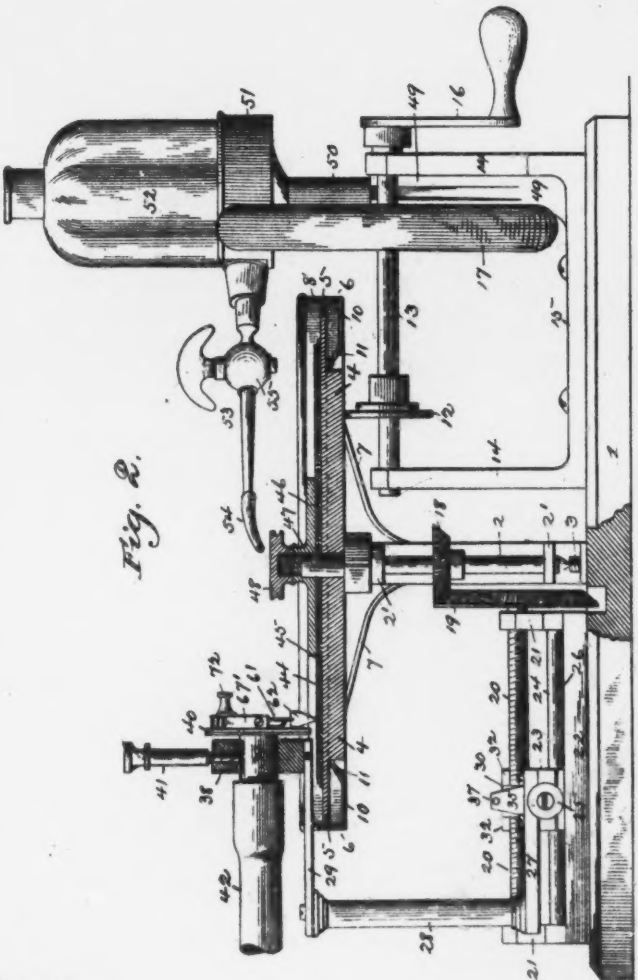


Fig. 2.

Witnesses:
J. B. McGirr.
F. F. Chapman

Inventor,
Emile Berliner,
By Joseph Lyons.
Attorney

454
(No Model.)

4 Sheets—Sheet 3.

E. BERLINER.

GRAMOPHONE.

No. 534,543. Patented Feb. 19, 1895.

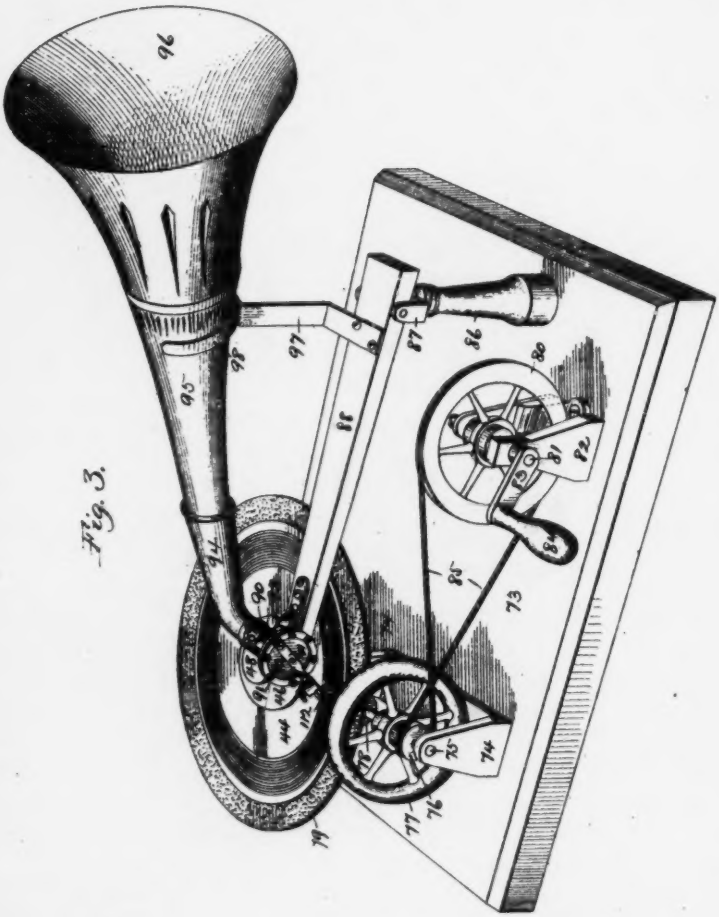


Fig. 3.

Witnesses:

Percy C. Brown

H. T. Chapman

Inventor:

Emile Berliner,

By Joseph Lyons.

Attorney.

455

(No Model.) 4 Sheets—Sheet 4.

E. BERLINER.

GRAMOPHONE.

No. 534,543. Patented Feb. 19, 1895.

Fig. 4.

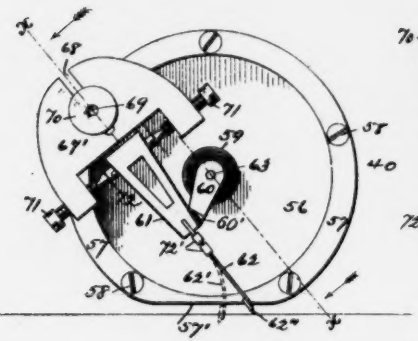


Fig. 5.

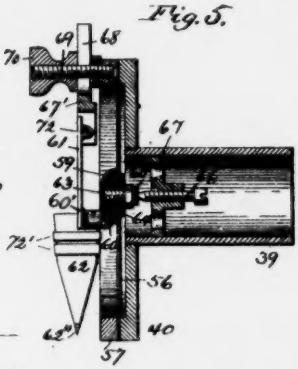


Fig. 6.

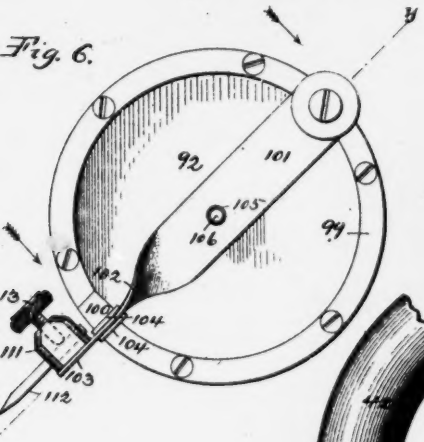


Fig. 7.

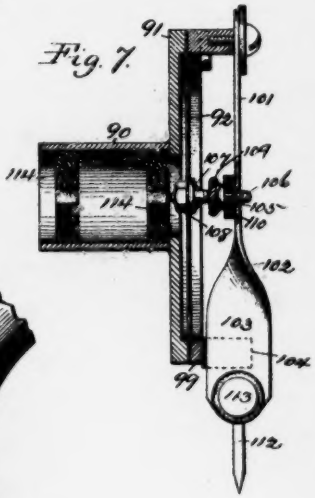
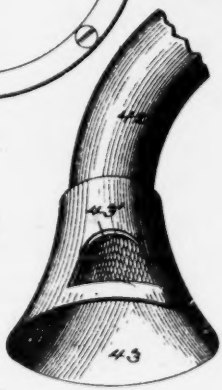


Fig. 8.



Witnesses:

Percy C. Bowen

G. J. Chapman

Inventor:

Emile Berliner,

By Joseph Lyon.

Attorney.

UNITED STATES PATENT OFFICE.

EMILE BERLINER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE UNITED STATES GRAMOPHONE COMPANY, OF SAME PLACE.

GRAMOPHONE.

SPECIFICATION forming part of Letters Patent No. 534,543, dated February 19, 1895.

Application filed March 30, 1892. Serial No. 427,060. (No model.)

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, and a resident of Washington, District of Columbia, have invented certain new and useful Improvements in Gramophones, of which the following is a specification.

My invention has reference to improvements in the method of and apparatus for recording and reproducing sounds, the improvements being more particularly directed to the construction of that kind of sound recording and reproducing apparatus which I have called "gramophone," and for which Letters Patent of the United States No. 382,790, dated May 15, 1888, have been granted to me.

One feature of my invention has reference to improvements in the method of recording sound by tracing upon a fatty film deposited upon a metallic surface, undulatory lines, corresponding to sound waves, and then etching such lines in the metal base, or as it is now commonly called, the record tablet; while the other features of my invention have reference to the construction of the details of both the recorder and the reproducer of the gramophone. Each of these features of improvement are designed to overcome certain difficulties, and to avoid certain imperfections heretofore met with in the operation of the gramophone. These difficulties and imperfections, and the manner in which they are avoided, will be particularly pointed out in the following detailed description with reference to the accompanying drawings, in which—

Figure 1, is a perspective view of my improved gramophone recorder. Fig. 2 is a side elevation, partly in section, of the recorder. Fig. 3 is a perspective view of a gramophone reproducer. Fig. 4, is an elevation of a recording diaphragm and stylus. Fig. 5, is a section of the same on the line x—x of Fig. 4. Fig. 6, is an elevation of the gramophone reproducing diaphragm and stylus. Fig. 7, is a section of the same on line y—y of Fig. 6, and Fig. 8, is a perspective view of an improved mouth-piece for the recorder.

Like numerals of reference indicate like parts throughout the drawings.

My improved gramophone recorder is shown as a whole in Figs. 1 and 2, mounted upon a suitable base 1. About midway of the length of this base there is an upright shaft 2, journaled in brackets 2', 2', stepped at its lower end in a suitable bearing 3. This shaft carries at its upper end a circular disk 4, the outer or peripheral portion of which is reduced in thickness as shown at 5, and this reduced portion extends over a ring shaped pan 6, supported by stays or brackets 7, from which it may be lifted and removed, when required. The outer edge or wall 8, of the pan is of sufficient height to project for a distance above the disk 4, and is provided with a curling lips 9, for a purpose hereinafter described. The bottom 10 of the pan extends under the reduced portion 5, of the disk 4, and its inner edge 11, is upturned close to the under side of the reduced portion of the disk, as shown.

Bearing against the under side of the disk 4, is a friction wheel 12, secured to a horizontal shaft 13, which latter is journaled in the upper ends of posts or uprights 14 constituting the ends of a frame, the base 15, of which is secured to the base 1 of the apparatus. The position of shaft 13, and the diameter of the friction wheel 12, are such, that a portion of the weight of the disk 4, and of its shaft 2, is supported by the friction wheel; whereby the bearing 3, is relieved from a portion of that weight, and whereby frictional gearing between the disk 4 and wheel 12 is insured, without requiring special adjustment. The shaft 13, carries at its outer end a crank 16, by means of which it is rotated; and between the two uprights 14, there is secured to the shaft a heavy fly or balance wheel 17. Secured to the upright shaft 2, below the disk 4, there is a beveled pinion 18, meshing with a large bevel gear 19, on one end of a horizontal screw-threaded shaft 20, which is arranged radial to the disk 4, and journaled adjacent to the said gear 19, and also at the other end, in pillow-blocks 24, supported on the end piece of a rectangular frame 22, which in turn is fast on the base 1. Mounted upon the frame 22, so as to be movable thereon in the direction of the length of the shaft 20, there is a carriage 23, supported at one end by a guide rod 24, on which it is free to slide, and at the other end by a roller 25, movable

along the upper surface 26, of one of the side pieces of the frame 22. The carriage 23, has firmly secured to it a projecting arm 27, on the outer end of which is an upright post 28, carrying at its upper end an arm 29, parallel with the arm 27, and of such length as to overhang the disk 4, when the carriage is moved to the right, as represented in the drawings; the construction being such, that when the carriage 23 is moved in the manner to be described, the arm 29, will be carried radially over the disk 4, and any object carried thereby will participate in said movement.

The carriage 23, is moved in one direction by means of the screw-threaded shaft 20, and in order to effect this operation, there is provided a block 30, in one side of which, near one end, is formed a half nut 31, constructed to engage the threads on the shaft 20; and this block 30, is pivotally supported between ears 32, erected on the carriage 23. Projecting from the other end of the block 30, there is a pin 33, to which one end of a spring 34, is attached, the other end of said spring being secured to the carriage 23, and the tendency of the spring is to maintain the block 30, in a tilted position with the nut portion raised out of engagement with the shaft 20. In order to lock the block 30, in engagement with the shaft 20 there is provided a leaf spring 35, mounted on the carriage 20, opposite the free end of the block 30, and having on its free end a tooth 36, which passes over the top of the hinged block 30, when the nut formed in the same is in engagement with the screw threads on the shaft 20, the tendency of the leaf spring 35, being to move inwardly toward the block 30. This catch spring 35, is also provided with a pin 37, which serves as a handle for withdrawing the catch so as to unlock the block 30, and thereby allow the carriage 23 with its appurtenances to be freely moved to any position upon the frame 22.

To the free overhanging arm 20, is secured a ring sleeve 38 which receives the neck 39, projecting on one side from the frame 40, in which latter the recording diaphragm and styles are mounted, and this neck 39, with its appurtenances is fixed in any desired position in the ring frame 38, by a clamp screw 41. The free end of the neck 39, projects beyond the ring frame 38, and receives the sound conveying tube 42, which is preferably made flexible, and which has at its free end a mouth-piece 43, the particular construction of which will hereinafter be more fully described.

The disk 4, which is in the nature of a rotary table, has hereinbefore been described and is shown in the drawings as reduced in thickness on that portion of the periphery which overlaps the inner wall of the pan 6, and if this construction is used, the disk 4, must be removable from the shaft 2. It is, however, also practicable to make the disk or revolving table, in two parts, the lower part of which extending only to within a short distance of the upper edge of the inner wall 11, of the pan, while the upper part extends over that edge to within a short distance of the outer wall of the pan. This is indicated by a dotted line in Fig. 2, and if this construction is adopted, only the upper thinner part of the table is removable from the upright shaft 2, while the lower thicker part of the table may be fixed to that shaft.

When a sound record is to be made, a record tablet of the kind described in my aforesaid Letters Patent, is placed upon the rotary table 4, and this record tablet is represented in the drawings as a circular disk 44, which has a central perforation passing over the upper end of the shaft 2. Sometimes it is convenient to interpose between the record tablet and the rotary supporting table a thin disk 45, of felt, or of some other non-resonant material. This, however, is not essential. Upon the record tablet is placed a clamping plate 46, which by preference is provided with a hub 47, which is slipped over the upper end of the shaft 2. This upper end of the shaft 2, is screw-threaded as shown, and a thumb-nut 48, is then screwed down upon the hub of the clamping plate, whereby the record tablet is securely fastened in position.

At one end of the base plate 1, there is mounted a standard 49, which may be a split tube as shown, and in which is supported by friction a stem 50, projecting from the bottom of a shelf 51, and which in turn supports a vessel 52, containing alcohol. From the bottom of this vessel extends a tube 53, preferably provided at its free end with a flexible nozzle 54; and a stop-cock 55, with which the tube is provided permits the operator to regulate the flow of alcohol from the nozzle. With my present improvement it is necessary that during the whole process of tracing the record, the record tablet be covered with a film of alcohol, and for this purpose a thin stream of alcohol is directed upon the center of the tablet, or rather upon the clamping plate 46, from which the alcohol spreads in all directions by centrifugal force, and flows over into the pan 6. When the tracing of the record has been completed, the clamping plate is removed and the record tablet also is lifted from its support by the insertion between the same of a sharp edge, such as a knife blade, or even by the finger nails of the operator, and is removed for further manipulation as described in my aforesaid Letters Patent, and also for the manipulation which will be described hereinafter.

Only a very small quantity of alcohol is used for producing a single record, but after continued use of the machine a considerable amount of alcohol accumulates in the pan, and this is removed by removing the table 4, or the upper, thinner part thereof, as the case may be, by inserting a finger in each of the pouting lips 9, and thus lifting the disk or table 4, from the shaft 2. The pan is then removed from the bracket 7, and the alcohol

is poured out and preferably back into the vessel 52, by one of the pouring lips.

The recording diaphragm 56, is mounted in the circular frame 40, between a ledge formed on said frame and an annulus 57, screwed down upon the same by screws 58, as shown, or in any other suitable manner. On the rear side of that diaphragm there is applied a small block 59, of hard rubber from which extends radially an arm 60, which at its free end is turned up at right angles, outwardly and into contact with the lever 61, which carries the recording stylus 62.

The block 59, is fastened to the center of the diaphragm by a screw 63, passing through the diaphragm and through a washer 64, applied to the front side of the diaphragm. The head of this screw is faced with a disk 65, of soft rubber, and against the same bears the point of an adjusting screw 66, which is mounted in a perforated disk or spider 67, fixed in the neck 39.

The lever 61 is mounted on a plate 67', formed with a slot 68, through which a set screw 69, fixed in the annulus 57, passes. The plate 67', can thus be adjusted to various positions on the annulus, and is clamped in the adjusted position by a thumb-nut 70. One end of the plate 67' is bifurcated, and screws 71, 71, passing through the legs of the fork, are formed at their ends with bearings for the pivot points of the arbor 72, which is fixed to the lever 61. This lever, is made as light as practicable and as is consistent with rigidity, and the plate 67', together with the lever 61, which it carries, is so adjusted that the upturned end of the arm 60, bears upon the lever at the greatest practicable distance from the axis of the spindle 72, viz: at the free end of the lever. The connection between the lever and the upturned end of the arm 60 is made by a small quantity of pitch, 60', which acts as an efficient cement, and which is applied after the lever has been adjusted to its proper position. This mode of connecting the lever with the arm 60, and thereby with the diaphragm, I have found to be of great advantage for a variety of reasons, but more especially on account of the ease with which the connection is made, and unmade in case of repair, and on account of the damping effect it has upon the lever.

To the end of the lever 61 is secured the recording stylus 62, by solder or otherwise, with its plane at right angles to the plane of the lever, as shown. The stylus is composed of a flat, and rather thin plate of spring steel, pointed at its free end, and provided with a tracing point 62'', of iridium. The broad portion of the stylus is damped by one or two bands 72', of soft rubber, which are simply slipped over the same.

By reference to Fig. 4, it will be seen that the lever 61, with the recording stylus 62 extend across the diaphragm upon a line which constitutes a chord but not a diameter of the circle of the diaphragm. They are, therefore, eccentrically mounted with reference to the center of the diaphragm; but notwithstanding this eccentric location, the lever is rigidly connected with the center of the diaphragm and thus receives the maximum amplitude of its vibration. By thus placing the lever with the stylus eccentric with reference to the center of the diaphragm both the lever and the stylus may be and are made shorter than if they were located on the line of a diameter of the diaphragm. This is an important result, since the shorter the lever and stylus, the less liability there is of lost motion, and the less liability there is of extra or spontaneous vibrations of the lever and stylus, and both of these facts conspire to produce an accurate tracing of the sound waves impinging against the diaphragm.

Where the stylus passes over the edge of casing 40, the latter, together with the annulus 57, is cut away upon a straight line, as indicated at 57'. This permits a further reduction of the length of the stylus, since the record tablet may be located close to the straight edge 57'.

The body of the stylus is normally curved downwardly, as shown in dotted lines at 62', but when the diaphragm holder or frame 40, is turned to cause the stylus to impinge upon the record tablet, which is the preparatory step for making a record, the stylus is unbent and becomes straight, as shown in solid lines in Fig. 4; and I have found that the best results are obtained when the stylus is at an angle of about forty-five degrees with the plane of the tablet. The maximum pressure of the stylus upon the record surface is therefore equal to the force required to unbend the stylus. It is very small, because the stylus is made as thin as practicable, and it is uniform for different records and for all parts of the same record.

The mouth piece, into which vocal sounds are uttered for recording, is shown at 43, in Figs. 1 and 8, and it consists of a bell shaped structure, the small end of which is secured to the sound conveying tube, while the wide, flaring end is turned toward the speaker who applies his mouth to the opening. Near the edge of the mouth opening there is a perforation 43', cut into the wall of the mouth-piece, and this perforation is of such shape and size, and at such distance from the edge of the mouth-piece, as to fit approximately the edge of the nose of the speaker; so that when the mouth-piece is applied, the sounds uttered by the mouth enter the wide, flaring opening, while the sounds uttered by the nose enter the perforation 43'.

In making a record of vocal sounds, it is necessary that all sound waves composing the words or the song be conveyed to the diaphragm, and it has, therefore, been proposed to make mouth-pieces of such size and shape as to admit within the opening both the mouth and the nose of the speaker or singer, and to fit against the face of the user around the

mouth and nose. Mouth pieces of this character are necessarily large and clumsy, and do not readily and comfortably fit different persons, while with my construction the size of the mouth-piece is reduced, and will comfortably fit different speakers.

By means of the apparatus so far described, a record of sound waves is made in the following manner: The spring catch 35, 36, is drawn back, which permits the spring 34, to lift the block 30, from the screw 20, so that the carriage 23, may be freely moved to the left, whereby the stylus 62, is carried beyond the edge of the rotary table 4. A record tablet prepared in the manner described in my aforesaid Letters Patent is then placed upon the table 4, and clamped to the same, as hereinbefore described, and the carriage 23, is moved toward the right until the point of the recording stylus is above the tablet but within the edge of the same. The casing 40, is then turned in its bearing 38, until the point of the stylus impinges upon the tablet and is unbent, as shown in Fig. 4. In this position the casing 40, is clamped by means of the screw 41. The stop-cock 55, is then opened and a thin stream of alcohol is directed upon the clamping disk 26. The wheel 17, is now rotated by means of the crank and handle 16, whereby, by means of the gearing described, the record tablet is rotated, while the stylus is carried across the face of the tablet in a radial line, removing from the tablet a fine spiral line of the fatty etching ground with which it had been covered. Sound waves are now directed against the diaphragm in any desired manner, and if vocal sounds are to be recorded, the sound conveying tube 42, with the mouth piece 43, will be used. The vibrations of the diaphragm thus produced will cause the stylus to make a tracing of an undulatory line, corresponding to the sound waves directed against the diaphragm; all as described in my aforesaid Letters Patent. During this whole time a thin stream of Alcohol is delivered upon the plate 46, and the alcohol spreading out in all directions is maintained as a uniform and constantly renewed film upon the tablet. In this manner every part of the record is made under alcohol, and in this respect my present invention differs from the process set forth in my aforesaid Letters Patent.

In accordance with the said patent, alcohol is poured once for all over the tablet, and is allowed to evaporate during the process of recording. I have found that in this manner it often happens that the alcohol has entirely evaporated before the record is completed, so that a portion of the latter is made upon a dry tablet; whereby the accumulation of filamentary particles of dust on the point of the stylus, which the alcohol is designed to avoid, takes place during the production of a portion of the record. With my present improvement this defect is cured, since it maintains the record tablet moist with alcohol from the beginning to the end of the operation.

After the tracing of the record has been completed, the tablet is speedily removed and before the record is fixed by etching as described in my aforesaid patent, the alcohol adhering to the record surface is quickly washed off with water. This is an important step in my improved process and greatly improves the definition of the record by etching. The reason for this is, that the alcohol slightly attacks and dissolves the fatty etching ground, so that the thin film of alcohol remaining upon the tablet, contains a slight quantity of that ground in solution. If now, the film of alcohol is allowed to evaporate an exceedingly small quantity of the dissolved ground is deposited upon the metal which has been laid bare by the stylus. This small deposit of ground sufficiently resists the action of the etching fluid to impair the definition of the final record. By simply pouring water over the record surface immediately after the tablet has been removed from the recording apparatus the film of alcohol and the ground held in solution by the same is removed, and the tracings of the stylus present a clean metallic surface, which is properly attacked by the etching fluid.

The reproducing apparatus as a whole is represented in Fig. 3.

Upon a base board 73, in standards 74, is journaled a shaft 75, upon which are mounted a driven pulley 76, a fly-wheel 77, and a friction disk 78. The latter is in frictional engagement with a rotary table 79, which is mounted upon a vertical shaft substantially in the manner described with reference to the rotary table 4, of the recording apparatus. Fig. 5, being a perspective view, the mounting of the table 79, is not visible, but is easily understood from the foregoing description. The upper surface of the table is preferably covered with a sheet of felt or other elastic and non-resonant material, as indicated by appropriate shading.

Upon the felt covered table 79, the record tablet 44, is placed and is clamped thereon substantially in the manner in which this is done in the transmitting apparatus, i. e., by means of a clamping plate 46, and a thumb-nut 48. A driving wheel 80, mounted on a shaft 81, which is journaled in standards 82, is rotated by means of a crank 83, and handle 84, and gives motion to the table 79, by means of a crossed belt or cord 85. The relation of the table 79, to the friction disk 78, is the same as the relation of the table 4, to the friction disk 12; that is to say, the table rests with the greater part of its weight upon the friction disk, so that the frictional gearing is automatically maintained. A post 86, mounted upon the base-board 73, has swiveled upon its upper end a fork 87, between the prongs of which is pivoted the swinging arm 88, which extends over the table 79, and has at its free end a clasp 89, which receives the neck 90, which projects from the center on one side of the casing 91, of the reproducing

diaphragm 92. This casing with its diaphragm, stylus and appurtenances, which will presently be described, can be thus turned in the clasp, and can be fixed in any adjusted position by a clamp screw 93.

Upon the end of the neck 90, which projects beyond the clasp 89, is slipped a flexible tube 94, which in turn receives the small end of a sound conveying trumpet 95, the flaring end 96 of which is turned toward the listener. A bracket 97, secured to the swinging arm 88, carries at its free end an elastic fork 98, which receives and supports the trumpet, and the parts are so proportioned that the free end of the swinging arm preponderates, so that the point of the reproducing stylus, which will presently be described, presses rather firmly upon the record tablet.

It will now be understood, that when a record tablet, having a record of sound waves upon its surface, produced in accordance with my invention, is mounted upon the table 79, and when the point of the stylus is adjusted in engagement with the record groove, and the wheel 80, is rotated, the rotating record groove will guide the stylus across the face of the tablet, and will at the same time vibrate the stylus and diaphragm in accordance with the undulations of the record groove. The sound waves thus produced by the diaphragm will issue from the flaring opening of the trumpet, and the sounds will be heard by a listener in front of the trumpet, or in its vicinity.

The reproducing diaphragm is mounted in the casing 91, in the usual manner, being held against a ledge by means of an annulus 99. On this annulus is formed a swelling or block 100, and diametrically opposite to the same the stylus carrying spring 101, is fastened to the annulus, and extends across the face of the diaphragm and beyond the edge of the annulus. This spring 101, is a leaf spring which faces with its flat side the face of the diaphragm up to a point beyond the center of the latter, and is then twisted at right angles, as indicated at 102, and crosses the annulus edgewise as shown at 103. The tendency of the part 101, of the spring is to press toward the diaphragm, whereby the edge of the part 103, is made to bear with some force upon the annulus 99: and the tendency of the part 103, is to press against the swelling or block 100. The spring is therefore elastic in two directions at right angles to each other.

In order to prevent grinding of the spring against the annulus and against the block 100, a U-shaped piece 104, of soft rubber embraces the outer portion 103, where it bears upon the annulus and against the block. This soft rubber cushion also serves as a dampener for the spring. At the point where the spring passes over the center of the diaphragm, it has a perforation 105, and a screw pin 106, secured to the center of the diaphragm by two nuts 107, 108, extends loosely through the perforation. A thumb-nut 109, also placed on the screw-pin 106, and a soft rubber washer 110 between the thumb-nut and the spring serve to regulate the tension of the latter and of the diaphragm, as will be readily understood.

On the free end of the spring 101, 103, there is secured a binding post 111, in which the stylus 112, is held by the set screw 113, and may be adjusted to project to the required distance beyond the end of the spring. This stylus is preferably made of hard steel. It has a slender point, but the point should not be so sharp as to cut the bottom of the record groove which it engages.

In the operation of reproducing the sounds recorded on a tablet, the stylus is guided by the walls of the record groove, and not by the bottom of the same. Consequently it is not essential that the point of the stylus be in contact with the bottom of the groove In fact it is preferably not in contact with the same, so that this point may be made rather dull.

The sounds emitted by the reproducing diaphragm are very powerful and ordinarily too loud to be received with comfort by a listener in front of the trumpet or other receiving tube. For this reason I have found it sometimes necessary to reduce the volume of the emitted sound before it reaches the ear, and this I accomplish by one or more perforated and exchangeable diaphragms 114, placed in the neck 90. These diaphragms should be made of some non-resonant material like soft rubber, or cork, as indicated by appropriate shading.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. The method of recording vocal and other sounds which consists in removing from a record tablet covered with a fatty film, undulatory lines of said film by, and in accordance with the sound waves and maintaining at the same time a layer of a fluid over the film, substantially as described.

2. The method of recording vocal and other sounds upon a rotating disk covered with a fatty film which consists in spreading over said film and continuously renewing over the same a layer of a fluid and at the same time removing from said tablet undulatory lines of the fatty film by and in accordance with the sound waves, substantially as described.

3. The improvement in the art of making a gramophone record which consists in immersing and maintaining the tablet and the point of the recording stylus in alcohol during the process of recording, substantially as described.

4. The improvement in the art of making and fixing a gramophone record which consists in removing from a tablet covered with a fatty film undulatory lines of said film by and in accordance with sound waves while said film is covered with a layer of alcohol; then immediately removing the alcohol with water and then subjecting the tablet to the

action of an etching fluid, substantially as described.

5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same along the record by and in accordance with the said record, substantially as described.

6. In a gramophone, a recording stylus pressing by its own elasticity upon the record tablet at right angles to the plane of its vibratory movements and consisting of a leaf spring terminating in a point of harder material than that of the body of the stylus, substantially as described.

7. In a gramophone, the combination of a sound receiving diaphragm and an elastic recording stylus controlled by the diaphragm and adjustable with reference to a record tablet so as to press by its own elasticity upon the same at right angles to the plane of its vibratory movements, substantially as described.

8. In a gramophone a recording stylus pressing by its own elasticity upon the record tablet at right angles to its plane of vibratory movements, and consisting of a leaf spring terminating in an iridium point, substantially as described.

9. In a gramophone, a recording stylus composed of a leaf spring terminating in a tracing point in combination with one or more elastic non-sonorous dampers, substantially as described.

10. In a gramophone a recording stylus formed of a leaf spring terminating in a tracing point in combination with one or more sleeves of soft rubber upon the leaf spring for damping the same, substantially as described.

11. In a gramophone, the combination of a sound receiving diaphragm, a lever and a recording stylus carried by the same, both extending parallel but eccentrically over the diaphragm; with a connection between the center of the diaphragm and the lever, substantially as described.

12. In a gramophone, the combination of a sound receiving diaphragm a lever and a recording stylus carried by the same, both extending over the face of the diaphragm, but eccentrically thereto, with a rigid connection between the center of the diaphragm and the free end of the lever, substantially as described.

13. In a gramophone, the combination of a circular sound receiving diaphragm, a lever and an elastic recording stylus both extending parallel with the diaphragm on the line of a chord, with a rigid connection between the center of the diaphragm and the free end of the lever, substantially as described.

14. In a gramophone, the combination of a sound receiving diaphragm, a lever and an elastic stylus carried by the same, both extending parallel, but eccentrically thereto; with a bracket rigidly connected with the center of the diaphragm and removably connected to the lever, substantially as described.

15. In a gramophone, the combination of a sound receiving diaphragm mounted in a suitable frame, a bracket adjustably mounted on said frame, a lever pivoted in said frame extending parallel to and eccentrically with reference to the center of the diaphragm, and an elastic recording stylus carried by the lever; with a mechanical connection between the center of the diaphragm and the free end of the lever, substantially as described.

16. In a gramophone a sound receiving diaphragm and a tube for conveying sound waves thereto in combination with a recording stylus receiving motion from the diaphragm, and a screw mounted in the sound conveying tube bearing centrally upon the diaphragm for adjusting the tension of the latter, substantially as described.

17. In a gramophone, the combination of a horizontal rotary table adapted to support a record tablet, and a vertical shaft free to move longitudinally, carrying the table; with a friction disk engaged by the under side of the table for rotating the latter, substantially as described.

18. In a gramophone the combination of a horizontal rotary table mounted upon a vertical shaft and adapted to support a record tablet; with a friction disk engaging the under side of the table and partly sustaining the weight of the table, whereby the latter is automatically maintained in frictional gear with said disk, substantially as described.

19. In a gramophone, the combination of a rotary horizontal table adapted to receive and support a flat record tablet; with a reservoir of a suitable fluid, such as alcohol, discharging upon the center of the table and tablet, and an annular pan disposed underneath the table for receiving the overflow of alcohol, substantially as described.

20. In a gramophone the combination of a horizontal rotatable table adapted to receive and support a record tablet; with a reservoir of alcohol discharging upon the center of the table and tablet, an annular pan disposed under the edge of the table for receiving the overflow of alcohol, and a friction disk bearing upon the under side of the table between the center of the same and the inner wall of the pan, substantially as described.

21. In a gramophone, the combination of a horizontal rotary table adapted to receive and support a record tablet, a recording diaphragm and stylus connected by gearing with the table to move radially over and with the stylus in operative relation to the same, substantially as described.

22. In a gramophone, the combination of a horizontal rotating table adapted to receive and sustain a flat record tablet, with a carriage movable in a line parallel to a radius of the table, a recording diaphragm and stylus carried by the carriage with the stylus in operative contact with the record tablet, and

gearing connecting the table with said carriage, substantially as described.

23. In a gramophone, a sound conveying tube provided with a mouth piece having a flaring opening for the application of the mouth of the speaker and a perforation in the side wall of the mouth piece separated from and spaced with reference to the mouth opening and shaped to correspond to the shape of the nostrils of the speaker, substantially as described.

24. In a gramophone a sound reproducing diaphragm in combination with a stylus lever extending diametrically across the same, and elastic in two directions at right angles to each other, substantially as described.

25. In a gramophone, the combination of a diaphragm and a stylus carrier composed of a leaf spring twisted at one point so as to bring the edge of one portion at right angles to the face of the other portion, whereby it is elastic in two directions, substantially as described.

26. In a gramophone the combination of a reproducing diaphragm and stylus; with a stylus carrier composed of a leaf spring extending flat-wise over the face of the diaphragm and edgewise over the edge of the diaphragm, substantially as described.

27. In a gramophone the combination of a reproducing diaphragm mounted in a suitable frame the latter being provided at one point with a boss or stop; with a double elastic stylus carrier composed of a twisted leaf-spring tending toward the diaphragm and against the boss or stop, substantially as described.

28. In a gramophone, a reproducing diaphragm and stylus in combination with an elastic stylus carrier extending over the face of the diaphragm and tending toward the same, of an adjustable connection between the diaphragm and stylus carrier and adjustable for varying the pressure between diaphragm and style carrier, substantially as described.

29. In a gramophone the combination of a reproducing diaphragm mounted in a suitable frame provided with a boss or stop; with a double elastic stylus carrier tending toward the diaphragm and toward the stop, and elastic non-resonant dampers interposed between the style carrier and the diaphragm and between the style carrier and the frame and stop, substantially as described.

30. In a gramophone a sound reproducing diaphragm and a sound conveying tube for the same, with one or more non-resonant perforated diaphragms in the said tube for reducing the volume of sound conveyed to the ear substantially as described.

31. In a gramophone a recording stylus pivoted to move in response to the vibrations of a diaphragm and elastic in a plane at right angles to such motions, substantially as described.

32. In a gramophone, a reproducing stylus having a wedge-shaped point engaging the walls of the record groove, substantially as described.

33. In a gramophone reproducer, a stylus carried or formed by a spring fixed at one end to the diaphragm holder and freely extending across and beyond the same and operatively connected with the center of the diaphragm, substantially as described.

34. In a gramophone reproducer, a spring constituting or carrying a stylus, fixed at one end to the diaphragm holder and extending across and beyond the periphery of the same and freely pressing against the diaphragm, substantially as described.

35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMILE BERLINER.

Witnesses:
HENRY E. COOPER,
F. T. CHAPMAN.

463
(No Model.)

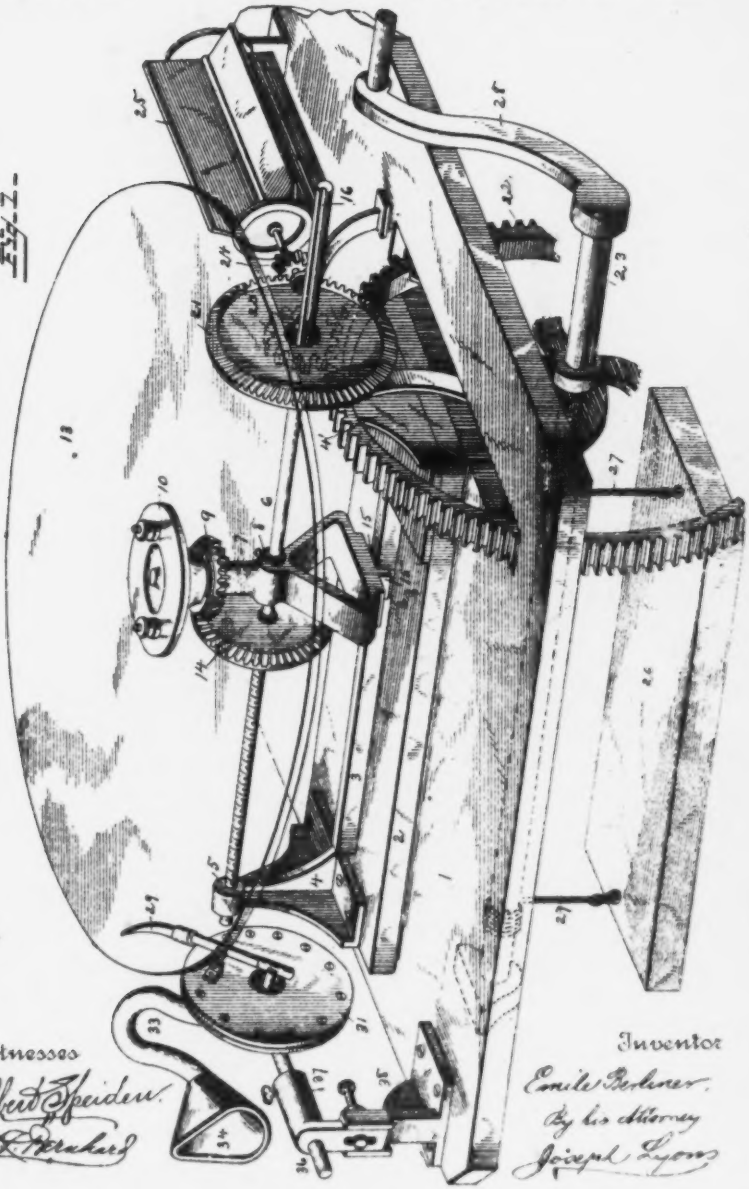
3 Sheets—Sheet 1.

E. BERLINER.

GRAMOPHONE.

No. 564,586. Patented July 28, 1896.

Fig. 1.



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464
(No Model.)

3 Sheets—Sheet 2.

E. BERLINER.

GRAMOPHONE.

No. 564,586. Patented July 28, 1896.

Fig. 2.

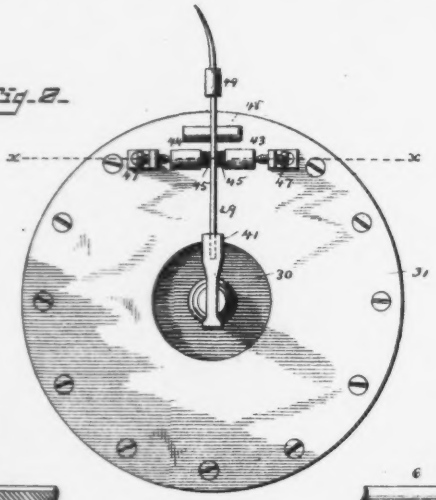


Fig. 6.

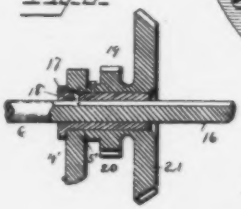


Fig. 7.

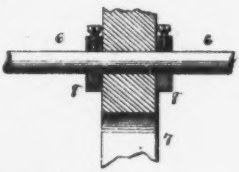


Fig. 4.

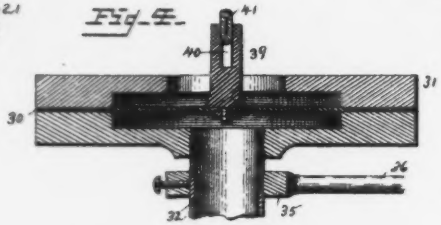
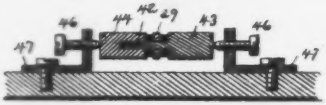


Fig. 5.



Witnesses

Albert Spuden.

H. Barnard

Inventor

Emile Berliner.

By his Attorney

Joseph Lyons.

465

(No Model.)

3 Sheets—Sheet 3.

E. BERLINER.

GRAMOPHONE.

No. 564,586. Patented July 28, 1896.

Fig. 9.

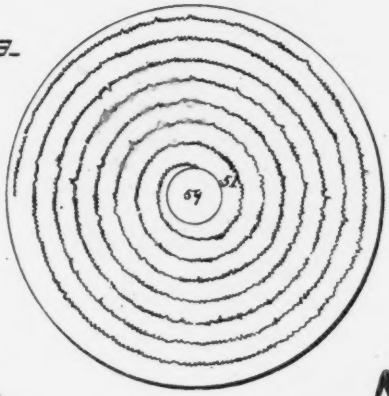


Fig. 8.

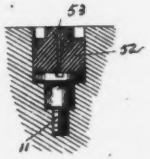


Fig. 10.

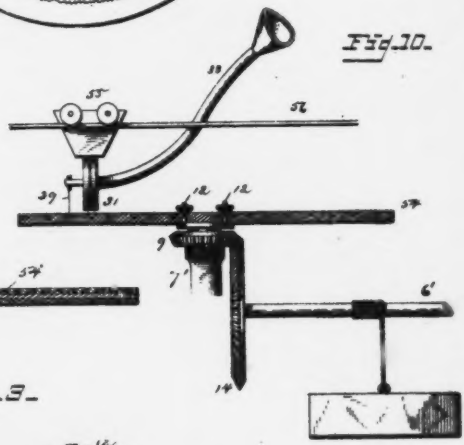
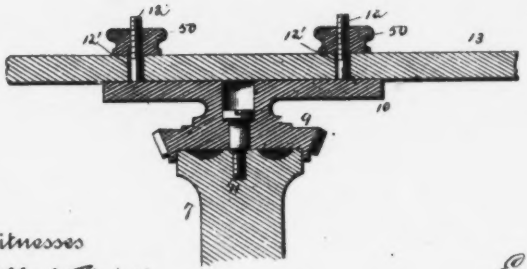


Fig. 11.

Fig. 3.



Witnesses

Albert Speiden.

H. Bernhard

Inventor

Emile Berliner.

By his Attorney

Joseph Lyons.

UNITED STATES PATENT OFFICE.

EMILE BERLINER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE UNITED STATES GRAMOPHONE COMPANY, OF WEST VIRGINIA.

GRAMOPHONE.

SPECIFICATION forming part of Letters Patent No. 564,586, dated July 28, 1896.

Application filed November 7, 1887. Serial No. 254,641. (No model.) Patented in England November 8, 1887. No. 15,232.

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Gramophones, of which the following is a specification.

My invention has reference to improvements in methods of and apparatus for recording and reproducing spoken words and other sounds, and it is primarily intended as and constitutes an extension and improvement of my gramophone which I have described in Letters Patent No. 372,786, granted to me on November 8, 1887, and for which I have also received Letters Patent of Great Britain, No. 15,232, dated November 8, 1887. In said patents I have described a method of recording and reproducing sounds, which consists in first causing the sounds to inscribe themselves upon a layer of non-resisting material in a manner substantially like that practiced by the well-known Léon Scott phonautograph, then copying the phonautographic record in solid resisting material, preferably by the photo-engraving process, and then reproducing the sounds from the solid copy of the record. The original record, as well as the copy of the same, is thus obtained as an undulatory line of even depth, as distinguished from a line of varying depth obtained by the ordinary phonograph and by the graphophone.

In my present invention I retain all the fundamental features of my gramophone, but introduce certain novel features both in the process and in the apparatus, which render the attainment of the objects of a sound recorder and reproducer more certain and more perfect.

In the original form of my gramophone I employed a curved (cylindrical) surface upon which the non-resisting medium used for recording was supported. This had the disadvantage that for the purpose of copying the record by the photo-engraving process such surface had to be first straightened and the flat copy obtained from the same had to be bent again to the original cylindrical form of the record-surface. This involved delicate and tedious manipulations, which I avoid in my present invention by inscribing the record of sounds upon a flat plate, and I further improve the process by arranging that flat plate horizontally, or nearly so, and by inscribing the record upon the under surface of the same, whereby the material removed by the recording-stylus drops away from the plate and leaves the undulatory groove of even depth, clean, and well defined, whereas by the old method the material removed by the stylus accumulated in and about the adjacent grooves.

I have further improved the process by using a transparent plate as a support for the non-resisting medium. This plate is therefore made either of glass or some other like substance, whereby I secure several important advantages. The most important of these advantages is that it enables me to work with parallel transmitted rays of light in the subsequent process of photo-engraving, in which the original record is thus used as a negative, which may be directly applied in contact with the sensitive photographic plate, and another important advantage is the reduction of the friction of the stylus upon the supports to a minimum.

The process is further improved by the employment of a new recording medium. In the original process I used a layer of lampblack pure and simple, and this substance is well adapted for the purpose on account of the slight coherence of the particles; but by reason of the flocculent nature of this substance the lines drawn upon it are more or less ragged, as can be observed under a microscope, and the photo-engraving obtained from such record displays all the defects of the original. In my improved process I employ a layer of a semifluid ink or paint, of such consistency and thickness that it will neither subside nor flow spontaneously. Such ink is practically structureless, and the lines drawn upon it are exceedingly sharp and reveal no ragged edges under a powerful microscope, and the photo-engraving from such record is far superior to a like copy from a record produced under the former process.

My invention also comprises other minor improvements in the process, and it also covers novel features in the apparatus, all of which

will more fully appear from the following detailed description, in which reference is made to the accompanying drawings, in which I have illustrated convenient forms of apparatus which I have used, without, however, limiting myself to the exact details of the same.

Figure 1 is a perspective view of my improved gramophone. Fig. 2 is a plan view of the diaphragm, with its support and accessories. Fig. 3 is a vertical section showing the recording-disk and its connection with the driving-wheel. Fig. 4 is a sectional view of the diaphragm, its support, and accessories. Fig. 5 is a cross-section on line x x of Fig. 2. Fig. 6 is a sectional view of a part of the driving-gear. Fig. 7 is a section showing the connection of the driven shaft with the support of the recording-disk. Fig. 8 is a sectional view of a centering device. Fig. 9 is a plan view, upon a reduced scale, of a disk with a record of sounds recorded upon the same in accordance with my invention. Fig 10 is a sectional elevation of a modified form of my reproducing apparatus, and Fig. 11 is a sectional view of a dampened reproducing-disk.

Referring now to the drawings, in which the details are marked by numerals, there is a platform 1, suitably supported, and upon this platform are mounted the operative parts of the apparatus. A metallic plate 2, provided with a longitudinal rib 3, is secured upon the platform, and standards 4 4', mounted upon plate 2, are provided with a nut-bearing 5 and a smooth bearing 5', (see Fig. 6,) respectively, for shaft 6, which extends through these bearings, as shown. One-half, more or less, of this shaft is screw-threaded, as shown, and enters the nut-bearing 5, and at a point near the middle said shaft passes loosely through a movable support 7, the position of which upon the shaft is determined by two collars 8 8, as indicated in Fig. 7.

The support 7 serves as a bearing for a bevel-gear 9, which is centrally perforated and widens out into a circular flange 10. Upon its under side the bevel-gear 9 is recessed, and said recess fits loosely over the upper end of support 7. A screw 11, passing loosely through the central perforation of bevel-gear 9, screws into the head of support 7, so that the bevel-gear can rotate about its axis, which coincides with the axis of screw 11. Two screw-pins 12 12, which may be either fixed or removable, project at diametrically opposite points from flange 10, and are designed to pass through two similarly-located holes in a glass plate 13, as will be more fully described hereinafter.

A bevel-gear 14, fixed upon shaft 6, engages bevel-gear 9, but provision is made for releasing gear 14 from the shaft, if desired, for a purpose which will be explained farther on. As stated above, the screw-threaded portion of shaft 6 passes through nut-bearing 5, and it will now be clear that if shaft 6 is rotated bevel-gear 9, with its flange 10, will likewise rotate, and will at the same time advance in a straight line, since shaft 6, screwing into or out of its nut-bearing 5, will carry bevel-gear 14 and support 7 with it. From the bottom of support 7 two lugs 15 15, one on each side of rib 3 of plate 2, serve to guide the support with the parts attached thereto in the line of said rib, which is, of course, parallel to shaft 6.

A part of the smooth portion of shaft 6 has a longitudinal groove 16 extending to the right-hand end of the shaft, as seen in Figs. 1 and 6, and a sleeve 17 loosely fitting this portion of the shaft has a pin 18, the end of which engages groove 16, as shown in Fig. 6, so that the shaft is free to slide longitudinally through sleeve 17 and will rotate with the same if the latter is rotated.

Sleeve 17 is fitted into bearing 5' of standard 4', so as to rotate within the same, and upon that part of the sleeve which projects beyond the bearing is keyed the compound gear 19. The latter is composed of a pinion 20 and a bevel-gear 21, and a rather large bevel-wheel 22, mounted upon a shaft 23 below platform 1, meshes with pinion 20.

A small bevel-gear 24 meshes with gear-wheel 21, and to the shaft of gear 24 are secured fans 25, which are thus driven at a high speed and serve as a regulator, as will be readily understood by those skilled in the art.

A weight 26 is suspended by cords or chains 27 from shaft 23, and if said shaft is turned by a crank 28, or otherwise, in one direction the cords or chains are wound upon the same, as indicated in Fig. 1, and the weight 26 is raised up toward the platform. If, on the other hand, the weight is allowed to descend, it will rotate shaft 23, this in turn will rotate gear-wheel 22, which, meshing with pinion 20, will rotate the latter and the connected shaft 6, and in the manner hereinbefore described support 7 will receive a rectilinear motion, while flange 10, upon bevel-gear 9, will both rotate and move in a straight line. For every complete revolution of bevel-gear 14 support 7 and bevel-gear 9, with its connected flange 10, will be moved in the line of a diameter a distance equal to the pitch of the screw-threads upon shaft 6, and it will now be understood that if a plate 13 is fixed to flange 10 and a fixed pencil or stylus be lightly pressed upon the plane surface of said plate a spiral line will be drawn upon the plate.

The recording-stylus 29 is mounted upon a diaphragm 30, and the diaphragm itself, which may be of any suitable sonorous material, is mounted in a case 31, and a rigid tube 32, projecting from one side of the case, communicates with a flexible tube 33 and a mouth or ear piece 34. The tube is clamped and may be adjusted in the direction of its length in a ring 35, formed at the end of a rod 36, which is adjustable in a support 37, and the latter is again adjustable vertically in a standard 38 mounted upon platform 1. A

metal post 39 is fixed to the center of the diaphragm, as shown, and its free end has an axial slot 40, into which a soft-rubber tube 41 is forced and flattened. The free end of the soft-rubber tube receives the stylus 29, which may be of metal or any other hard and fairly elastic material.

Preferably the stylus is made of a flat strip of phosphor-bronze extending radially over the face of casing 31 and some distance beyond the edge of the same. At its free end the stylus is reduced to a point and is curved upwardly, and by turning the diaphragm-case about the axis of tube 32, or by turning rod 36 in its bearing 37, or by adjusting the latter upon bracket 38 the point of the stylus may be brought into light contact with the lower face of disk 13 at a point in the diameter of said disk which is parallel with shaft 6.

Near the middle of its length a hole is produced through the stylus, and a pin 42, formed at one end of a metal block 43, passes through said hole and into the central bore in a similar block 44. Between each block and the adjacent face of the stylus a soft-rubber washer 45 is inserted, and the two blocks are forced together and are made to clamp the stylus between the rubber washers by means of the pointed screws 46, working in the supports 47. The screws 46 46 thus constitute the pivotal supports of the stylus, which is a true two-armed lever. A piece of soft-rubber tubing 48 is inserted between the outer arm of this lever and the casing 31, and another piece of soft-rubber tubing 49 is slipped over the stylus between the elastic support 48 and the outer end. Thus it will be seen that the stylus is elastically supported and amply dampened, and that if the diaphragm vibrates under the impact of sound-waves the free end of the stylus will move to the right and to the left of its position of rest and parallel to the face of disk 13.

The disk 13 is preferably made of glass. It is of suitable diameter and thickness, and has two holes 12' 12', corresponding to the pins 12 12 projecting from flange 10, and is placed in position upon said flange with the pins entering the holes. The nuts 50 50 are then screwed down, whereby the glass disk is securely clamped.

The method of recording and reproducing recorded sounds by means of this apparatus will now be easily understood.

As has been stated above, the non-resisting material upon which the sound-record or phonautogram is produced is a semifluid, and I can use for this purpose any ink, as, for instance, printers' ink, of the required consistency. An even layer of this ink may be spread over the under surface of the glass disk in any suitable manner, as, for instance, by means of a brush or roller while the disk is slowly turned; but I prefer to produce the ink directly upon the disk itself, and I proceed in the following manner: The under surface of the glass disk is first carefully polished and dried, and is then covered with a thin film of oil by means of a camel's-hair brush. This is done while the disk is rotated with moderate speed. Any oil or fat may be used, but I have found linseed-oil specially adapted for the purpose. A smoky flame is then held under the glass plate while the latter is slowly rotated, whereby the lampblack ascending from the flame is intercepted by the plate and becomes deposited upon the same in a very fine layer, which, however, is instantly absorbed by and mixes intimately with the thin layer of oil, thus forming a black amorphous ink, covering the under surface of the glass disk in an even exceedingly thin layer. It is essential that the lampblack be deposited upon the oiled disk by the described process of sublimation; that is to say, the carbon particles must reach the disk and mix with the oil at the moment when their transition from the gaseous into the solid state takes place. If it were attempted to apply lampblack already formed by dusting upon the oiled disk, no intimate mixture resulting in an even layer of amorphous ink would be obtained. The coating of ink thus directly formed upon the disk has just the consistency and the thickness required. It will not flow spontaneously, and while it adheres well to the glass plate, it requires only a minimum force to remove it from the same, and the point of the stylus in its passage through the substance of the ink experiences no perceptible resistance. The disk is now ready to receive the phonautogram, and it is moved to the position shown in Fig. 1, with the point of the stylus near the outer edge. The point of the stylus is then adjusted into light contact with the disk, so that the coat of ink is barely penetrated by the same, and the weight 26 is allowed to descend and to rotate shaft 6 in the manner hereinbefore described. If now the stylus remained immovable, it would describe upon the under surface of the disk a smooth spiral the convolutions of which continuously decrease toward the center of the disk. The pitch of the spiral is determined by the pitch of the screw upon shaft 6 and by the relative angular velocities of said shaft and of bevel-gear 9, and may in practice be made as small as one-fiftieth of an inch. If now during the progress of the disk sound-waves are directed against the diaphragm through the mouth-piece 34 and tubes 33 and 32, the stylus will vibrate to the right and left of the spiral line, inscribing upon the disk an undulatory line of even depth, which line will truly and accurately represent the sounds uttered against the diaphragm. The stylus removes a very sharp line of ink from the disk, leaving the latter quite transparent at this line, while it is quite opaque and will not transmit light at the places not touched by the stylus. The ink removed by the stylus drops away from the disk, as stated above, and does not accumulate in and about the grooves.

An approximate idea of the phonautogram thus produced can be obtained by inspection of Fig. 9, which represents an undulatory spiral line upon a disk, with the pitch of the spiral and the undulations of the record greatly exaggerated. In the drawings, the undulatory line appears black upon a white ground, while in fact the line is transparent upon a black ground.

The phonautogram may extend to within a short distance from the edge of flange 10, and in practice the cords or chains 27 27 are made just long enough to drive the disk up to that limit, or the apparatus is mounted at the proper height above the ground so that the weight will be arrested before the limit of progress of the disk is reached. Bevel-gear 14 is then disengaged from bevel-gear 9 by unclamping the same from shaft 6 and sliding it upon the same a short distance to the left hand, (in the view shown in Fig. 1,) and the disk is then given a single rotation by hand, whereby the stylus describes a true circle 51 upon the disk. This circle, which I call the "centering-circle," is afterward utilized, as will presently appear. The glass disk, with the sound-record and centering-circle upon the same, is now removed, and the record may be fixed by applying a thin coat of varnish. It may then be handled with impunity. From this record I produce a copy in copper or any other metal by the process of photo-engraving, and in this process I use the original record as a negative, which enables me to work by transmitted light and with parallel rays, the negative being applied directly in contact with the sensitive photographic plate. The copy thus produced will have the exact size of the original, as is well understood by those skilled in the art. In the photo-engraved copy the sound-record appears as an undulatory line of even depth upon a solid metal disk, and the centering-circle 51 is reproduced in the same manner.

For reproducing the original sounds, the center of the centering-circle is determined by well-known simple geometrical constructions, and a small hole is drilled through that center, which hole corresponds to the mathematical axis about which the glass disk had been rotated, and also marks the axis about which the metal disk must be rotated by the apparatus shown in order that the pointed stylus applied to the starting-point of the record may follow the same from beginning to end. Two holes corresponding to the holes 12′ 12′ in the glass-disk are also made in the metal disk, but these holes are preferably made large enough to permit the disk to be adjusted in either direction when placed upon flange 10. Before this is done a well-fitting cylindrical block 52 is placed into that part of the cylindrical hole through the common center of flange 10 and bevel-gear 9 which is occupied by the head of screw 11, as shown in Fig. 8. This block, which I call the "centering-block," has a fine axial hole 53, which corresponds exactly to the mathematical axis of rotation of bevel-gear 9. If now the photo-engraved copy of the record is placed upon flange 10, with pins 12 12 passing through corresponding holes in the metal plate, a fine pin, say a sewing-needle, is passed through the centering-holes in the disk and in block 52, and the clamp-nuts 50 are tightly screwed down. By this simple process the metallic copy of the original record is safely and quickly centered in position. The stylus is then adjusted with its point in engagement with the outer end of the record-groove, and the weight 26 is allowed to descend. It will now be clear that the stylus will be forced positively to follow the undulations of the record, and that the diaphragm vibrating under the stylus will emit the same sounds which produced the original record, which sounds can be distinctly heard at the ear-piece 34.

Both the process and the apparatus thus far described may be modified in various ways without departing from the main features of my invention. So, for instance, I can dispense with the centering device and can rotate the record upon a stationary axis, if the diaphragm with its attached stylus is mounted in a manner to make it follow the spiral record. An arrangement of this character is shown in Fig. 10. The reproducing-disk 54 is in this case mounted as hereinbefore described, but without regard to the centering device. The support 7′ may be fixed in position so that the bevel-gear 9, mounted upon the same in the manner described with reference to Fig. 3, will turn without progressive motion. Bevel-gear 9, and with it the reproducing-disk 54, are rotated by a bevel-gear 14′ upon a shaft 6′, to which power is applied by a weight, as shown, or in any other suitable manner. The diaphragm-casing 31 is secured to a small truck 55 upon rails 56 arranged vertically above and parallel with a diameter of the reproducing-disk, and at such height above the same that the stylus 29 will be in engagement with the undulatory grooves of even depth which represent the record of sounds.

The listener applies his ear to the ear-piece, and when the shaft 6′ is rotated the stylus and diaphragm will be forced to vibrate, as in the apparatus shown in Fig. 1, but will at the same time move with the truck 55 across the face of disk 54. A tolerably good reproduction may also be obtained by simply holding one end of a reed between the teeth and the other pointed end of the same in engagement with the record-grooves while the disk is rotated.

The frictional contact of the reproducing-stylus with the surface of the ordinary metallic record gives rise to disturbing sounds, and with a view of avoiding the same I mount the reproducing-disk 54 (see Fig. 11) upon a rigid plate 58, and with a sheet 57, of

felt, soft rubber, blotting-paper, or other non-sonorous substance intervening. This dampens the extraneous vibrations of the reproducing-disk and renders the sounds emitted by the diaphragm very clear.

Additional clearness is obtained by nickel-plating the metallic record, which is ordinarily made of copper, since I have found that the sound due to the frictional contact of the stylus with a polished surface of nickel is very faint.

In place of the metallic copy of the original record I can use a copy made of sealing-wax, which is made from a metallic or other copy having the record in raised lines. The metallic copy is for this purpose first oiled and the molten sealing-wax is then poured over it and is then backed by plaster-of-paris or other rigid material. The cast is then easily removed from the metallic matrix and may be used for the reproduction of the recorded sounds, which will be quite clear and remarkably free of the disturbing sounds due to the friction of the stylus, especially when the surface is first gently rubbed with plumbago.

The metallic copy of the original record is in effect an engraved copper plate, and it may be used as such for printing upon paper, which then yields a copy in raised lines, as is well understood, and from this paper copy the sealing-wax copy or a copy of any other similar material may be made.

I desire to emphasize the fact that my recording and reproducing stylus is a flat elastic strip, which will yield in one direction, but not in the other. For this reason the recording and reproducing surface need not be absolutely plane, and the stylus will still retain contact with the same, while it will be positively moved to follow the undulations of the record in reproducing. The point of the stylus may be made of iridium.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method of producing a phonautogram, which consists in removing an undulatory line of even depth of a deposit of ink from a traveling plate, by and in accordance with sound-vibrations; substantially as described.

2. The method of producing a phonautogram, which consists in removing an undulatory line of even depth of a deposit of amorphous ink from a traveling support, by and in accordance with sound-vibrations; substantially as described.

3. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth of a deposit of ink from a traveling plate of glass, by and in accordance with sound-vibrations; substantially as described.

4. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth from a deposit of amorphous and opaque material from a traveling support of glass, by and in accordance with sound-vibrations; substantially as described.

5. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth extending along a volute, of a deposit of amorphous and opaque material from a rotating disk of glass, by and in accordance with sound-vibrations; substantially as described.

6. The method of producing a layer of semi-fluid ink upon a phonautographic support, which consists in first applying a coat of oil, or other fat, upon the support, and then sublimating upon the oiled surface a thin layer of lampblack; substantially as described.

7. The method of producing a phonautogram, which consists in removing an undulatory line of non-resisting material from the under surface of a traveling plate, by and in accordance with sound-vibrations; substantially as described.

8. In a gramophone, the combination of a sound-receiving sonorous body; with a pivoted stylus controlled by and controlling the same, and a support adapted to carry a phonautogramic recording-surface, or a copy of such record in solid resisting material, traveling in the plane of vibration of the point of the stylus; substantially as described.

9. In a gramophone, the combination of a sonorous diaphragm and a pivoted stylus; with an elastic connection between the diaphragm and stylus, and an elastic reactionary dampening-support for the free arm of the stylus; substantially as described.

10. In a gramophone, the combination of a pivoted stylus, with an elastic connection between the diaphragm and the stylus; substantially as described.

11. In a gramophone, the combination of a vibratory diaphragm and a stylus controlled thereby and controlling the same; with a rubber tube clamped to the diaphragm and connecting the stylus with the latter, and a pivoted support for the stylus between its free end and its connection with the diaphragm; substantially as described.

12. In a gramophone, the combination of a vibratory diaphragm and a stylus elastically connected therewith; with a pivoted support for the stylus located between the free end of the same and its connection with the diaphragm; dampening-washers between the stylus and its pivotal support, and a reactionary dampening-support for the free arm of the stylus; substantially as described.

13. In a gramophone, the combination of a horizontal traveling support for the record-surface; with a vibratory diaphragm, and a recording-stylus bearing upon the under surface of the support; substantially as described.

14. In a gramophone, the combination of a

metallic record of spoken words or other sounds; with a backing of non-resonant material; substantially as described.

15. In a gramophone, the combination of a sound-receiving diaphragm, mounted in a suitable casing; with a tubular sound-conveying stem projecting from the casing, and an adjustable support for the tubular stem; the connection between the casing and tubular stem being such as to permit of the rotation of the casing relative to the stem for adjustment, substantially as described and for the purpose set forth.

16. A device for centering a spirally-extending record, of sounds upon a reproducing apparatus, consisting of a rotatable record-support having a central recess, a block fitting the said recess and having a perforation coincident with the mathematical center of rotation of the record-support, and means for holding the record upon the support, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMILE BERLINER.

Witnesses:
JACOB G. COHEN,
CHAS. W. HANDY.

[Fourth Edition.]

A.D. 1878, 24th APRIL. N° 1644.

Recording and Reproducing Sounds.

LETTERS PATENT to Thomas Alva Edison, of Menlo Park, in the State of New Jersey, United States of America, for the Invention of "IMPROVEMENT IN MEANS FOR RECORDING SOUNDS, AND IN REPRODUCING SUCH SOUNDS FROM SUCH RECORD."

PROVISIONAL SPECIFICATION left by the said Thomas Alva Edison at the Office of the Commissioners of Patents on the 24th April 1878.

THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America. "IMPROVEMENT IN MEANS FOR RECORDING SOUNDS, AND IN REPRODUCING SUCH SOUNDS FROM SUCH RECORD."

My present improvements are for more fully developing and perfecting the device heretofore invented by me, and known as the "phonograph." By extensive experiment and research I have been enabled to obtain very perfect articulation and to produce a record in a convenient form for preservation.

The sound vibrations are made to move a point that by preference is a diamond or other very hard substance and of a peculiar shape. The sound vibrations in the atmosphere act upon a diaphragm or other body capable of motion, and the same moves the indenting point, and acts as a phonograph. The indented material is properly designated a phonogram, and it is preferably metallic. Sometimes tin-foil is used upon a grooved surface; sometimes a thin sheet or leaf of metal is placed upon a piece of paper having a surface of parafin or similar material. Sometimes the metallic surface is copper, and where a matrix has been made of steel or iron by electrotype deposit, or otherwise, upon the phonogram it may be hardened and used for impressing a sheet or roller of metal, and thereby the original phonogram can be reproduced indefinitely in metal that may be hardened and used for any reasonable length of time to utter the sentence, or words, or sounds phonetically.

The instrument or portion of the instrument that reproduces the sound from the

phonogram I term a "phonet." In order to facilitate production, use, and preservation of the phonograms I employ a ring or margin of thick paper or pasteboard, caused to adhere to the foil or sheet by resinous substance; this is used as a gauge in placing the sheet in the instrument or replacing the same in the phonet. I find that a disc revolved by gearing, and a weight or spring, and the movement regulated by a fan or governor, is a convenient device for presenting the surface to be indented to the phonograph, and the phonograph is on an arm that swings towards and from the centre of the disc, and is guided by grooves or other convenient mechanism.

The phonet device takes the place of the phonograph device when the sounds are to be reproduced.

When the sheet of material is wrapped around a cylinder its edges are passed down into a slit and held firmly. Either the cylinder may be moved endwise by a screw, or the phonograph or phonet devices be moved along the cylinder, and where the same sound is to be reproduced periodically, as calling out the hours of the day in a clock, or reproducing the sounds of animals in toys, the phonet is to be brought to the place of beginning automatically.

The phonographic devices employed by me are preferably a diaphragm of metal, against which the sound vibrations act. Sections of rubber tube applied to the surface act as dampers to prevent false vibrations; pieces of felt or similar yielding material may be used for the same purpose, and a small delicate hoop of spring metal between the diaphragm and the indenting point renders the phonogram more perfect than it would be if the diaphragm acted upon the point direct. A similar effect is produced by a disc upon the arm that carries the point, said disc being so close to the diaphragm that the atmosphere will produce the vibrations. It is often advantageous to use a case between the mouth of the speaker and the diaphragm to gather or hold the sound, and in some instances the head of the speaker should be inserted into this case up through a hole in the bottom. The mouth-piece is sometimes slotted or perforated, and has irregular edges to re-inforce the hissing sounds, and sometimes a membrane of rubber or gutta percha is fitted to the teeth, and forms a bag between the lips and the diaphragm.

The disc upon the arm that carries the point as aforesaid may be acted upon by a magnet, and the current through a helix from a diaphragm, or the motion of the arm and points may serve to set up a secondary current through such helix in consequence of the motion given by the phonogram to the point. The arm carrying the point in this latter case should be magnetised.

The phonogram may be produced by the direct action of air concentrated to the spot by a funnel terminating with a small hole, the end of the funnel being almost in contact with the moving surface to be indented.

When the foil is perforated instead of indented it can be rolled up in the form of a horn or cylinder, and revolved, and the articulation result from air blown from the end of a small tube passing through the perforations as they are presented in succession. Leverage is sometimes employed between the diaphragm and the phonogram, either to lessen or increase the motion of the phonographic action in recording, or of the phonetic action in speaking, and for recording quartette, trio, and other characters of singing, two, three, four, or more phonographic devices are employed upon one cylinder or plate, and the sounds will be reproduced by corresponding phonets; or where singing is conveyed through tubes to one diaphragm the phonographic record will be the combined tones, and the reproduction by the phonet will be complete and correct.

I find that an arm at right angles to a diaphragm, with a point resting upon the phonogram, will reproduce the tones by the weight and leverage of the arm moving the diaphragm. The phonogram may be in the form of a disc, a sheet, an endless belt, a cylinder, a roller, or a belt, or strip, and the marks are to be either in straight lines, spiral, zig-zag, or in any other convenient form, so long as the apparatus is adapted to bringing the same into contact with the phonet or speaking part of the apparatus, and the reproduction of the phonogram from a matrix or copy in relief

of an original phonogram may be made upon a belt, roller, cylinder, plate, or other convenient surface.

For amusement and instruction this phonograph is capable of extended use. For instance, a revolving cylinder containing phonograms of the letters of the alphabet and phonet keys, with corresponding letters on them, can be used in teaching the alphabet; and phonogram sentences, speeches, and other matters can be spoken by the phonet and repeated by the learner without the eyesight being called into use. For amusement or instruction the phonogram can be of a dog's bark, a rooster's crow, a bird's song, a horse's neigh, a lion's roar, and the like, and the phonogram can be used in a toy animal with a single phonet for the reproduction of the original sound.

This phonograph or speaking machine applied to a mask produces a semblance of vitality if the phonogram is made to operate upon moveable lips by levers, and in the production of such a phonogram a portion of the surface is to be indented by delicate levers and points, receiving motion from the lips during articulation; thereby a correct reproduction of the motion of the lips is obtained.

In connection with the phonet it is important to avoid the sound that usually results from the rubbing action of the phonogram upon the point. I am enabled to prevent this by an electric action between the point and the phonogram. In this case the phonogram should be of iron, and the point of steel and the parts magnetised so as to slightly repel each other; the point will follow the undulations and reproduce the sounds by the phonet. It is important that the point used in the phonet correspond in shape to that of the phonograph, but slightly smaller, so as to follow the bottom of the depressions without contact upon the sides. The diaphragm or other body employed in the phonet to receive motion from the phonogram is connected with a funnel of paper or other resonant substance that acts as a sounding board to render the phonet louder and more distinct.

Edison's Improvements in Recording and Reproducing Sounds.

SPECIFICATION in pursuance of the conditions of the Letters Patent filed by the said Thomas Alva Edison in the Great Seal Patent Office on the 22nd October 1878.

THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America. "IMPROVEMENTS IN MEANS FOR RECORDING SOUNDS, AND IN REPRODUCING SUCH SOUNDS FROM SUCH RECORD."

This Invention consists in means for recording in permanent characters the sounds made by the human voice in speaking and singing, those made by musical instruments, birds, animals, or any sound whatever, and in means for reproducing those sounds at any desired time.

The sound vibrations act upon a diaphragm or other body capable of motion; this diaphragm is at the back of a chamber provided with an opening or mouth-piece, and to this diaphragm an indenting point is secured. This instrument I term a "phonograph." The phonograph is adjusted to position with its indenting point contiguous to a moving surface covered with a thin sheet of metal foil or other suitable material, or else the surface with the metal foil is stationary, and the phonograph movable. The surface upon which the metal foil is secured is by preference grooved spirally, and this indenting point indents the foil in the line of this groove as the diaphragm is moved back and forth by the sound vibrations; these indentations are a record of the sound waves, and form the characters for reproducing the sounds. This indented sheet I term a "phonogram." The instrument or portion of the instrument that reproduces the sound from the phonogram I term a "phonet." It is similar in construction to the phonograph, being provided with a diaphragm and point, but the mouth-piece is by preference funnel-shaped to render the sound loud and distinct. The sounds are reproduced by the phonet being adjusted to place so that the point of its diaphragm is at the beginning of the spiral line of indentations, and as the surface containing the indented foil is moved the diaphragm of the phonet is vibrated by the point passing from one indentation to the next, hence the diaphragm receives the same movement from the indentations as when making those indentations, consequently the sounds made by the phonet will be the same as those that operated upon the diaphragm of the phonograph.

In the Drawing Fig. 1 is a section of the phonograph and sectional elevation of the mechanism for presenting the surface to be indented; and Fig. 2 is a plan of the same.

The phonograph is made of the body portion *a*, diaphragm *b*, and indenting point *c*. The body portion *a* has a central opening forming the mouth-piece into which the person speaks, or through which opening the sound vibrations pass to act upon the diaphragm, and the diaphragm is secured at its edges to the body *a*, leaving a space between the body and diaphragm in order that the diaphragm may vibrate freely. The indenting point should be a diamond or other very hard substance. The diaphragm is made of a thin sheet of iron or other material, and it is preferable to place the indenting point upon a delicate spring arm e^2, and to employ a short piece of rubber tubing e^3 between the spring and diaphragm; this rubber acts as a damper to prevent false vibrations of the diaphragm. The phonograph is upon a lever arm *i* pivoted at 5 to the vertical stud 6, so that the phonograph may be raised or lowered vertically, or moved horizontally for a purpose hereafter explained.

It is now to be understood that if a person speaks with his mouth near the mouth-piece of the phonograph the sound vibrations will act upon the diaphragm, and vibrate it, and communicate to the indenting point a similar movement, and

that if a piece of metal foil or other material susceptible of being indented is placed beneath or behind the indenting point and caused to move regularly, or the indenting point moved over the material, that said material will be indented and form a perfect record of the sound vibrations. I will now describe the means for sustaining the sheet to be indented, and the mechanism for moving the same:—*d* is a disk or plate secured to and turning with the shaft *e*, and hinged to this disk is a ring frame *f*; this disk *d* has two spiral grooves 3, 4, in its surface. There are pins 2, 2, upon the surface of the disk, and holes at corresponding places in the ring frame; the sheet to be indented is of a size and shape to correspond with that of the disk *d* and frame *f*, and said sheet has holes in it corresponding to the position of the pins 2, 2, and these holes form register marks in placing or replacing the sheet upon the disk *d*, and after the sheet is so placed the ring frame *f* is brought down upon the sheet and holds it firmly in place. There may be a central opening in the indented sheet of a size slightly larger than the space occupied by the spiral 3, and the outer edges of the sheet are stiffened by a ring of thick paper or pasteboard caused to adhere by glue or other adhesive material. The surface of the disk *d* is made with two spiral grooves 3 and 4 as aforesaid; the groove 3 is a guide for a pin that is upon an arm *g* on the phonograph, and the groove 4 is for the indenting point *c*. As the disk and sheet are revolved the groove 3 causes the indenting point to occupy a position immediately over the line of the spiral 4, and the indentations will be made upon the sheet of foil in a line corresponding to that of the spiral 4, shown in Fig. 2. The indentations made in the foil are a complete record of the sound vibrations that acted upon the diaphragm *b*, and from this indented sheet, which I term a "phonogram," the sounds are reproduced. The phonograph is carried outwardly by the spiral 3, and in so doing the parts swing upon the vertical stud 6. By depressing the outer end of the lever *i* the phonograph is raised so that it can be swung aside from the disk *d* to allow of the ring frame *f* being thrown back and the indented sheet or "phonogram" removed from the disk. The shaft *e* is revolved by a weight or spring, and gearing at *h*, and the spring is wound up by moving the lever *k* back and forth, which acts upon a ratchet and pawl of ordinary construction; *l* is a lever provided at its outer end with an inclined groove, in which is a pin on the lever *m*, and the other end of this lever *m* is connected with the coupler m^1 by moving the lever *l* one way or the other, the shaft *e* will be connected to or disconnected from the gearing *h*, and hence the disk *d* stopped or started at pleasure without interfering with the motor. As it is necessary that the shaft *e* should be revolved with uniformity I provide a governor at *n* to prevent the apparatus revolving too rapidly; and this may be made as in Figs. 1, 3, & 4, in which there are metal blocks *o* at the ends of spring arms from a cross head on a shaft that is driven by the gearing *h*, said blocks swinging radially and acting against the interior of a stationary cylinder *p* if the speed becomes too great, thereby checking the speed by the friction of the blocks against the cylinder. These spring arms may be secured at one end to a prismatic block as shown in Fig. 5. It is preferable to cover the surface of the blocks *o* next the cylinder *p* with felt or similar material that will slide upon the interior surface of the cylinder *p*, but produce more or less friction, according to the centrifugal action.

The guide spiral 3 may be dispensed with, and either of the devices shown in Figs. 6, 7, 8, or 9 made use of. In Figs. 6 and 7 the shaft *e* projects above the surface of the disk *d*, and there is a tooth upon the shaft contiguous to a rack bar extending from the phonograph, hence each revolution of the shaft, the rack bar, and phonograph will be moved the space of one tooth, consequently the lines of indentations will be parallel and concentric to the shaft *e*, excepting at the places when the tooth acts to move the rack bar and phonograph outward or inward. In this case the spiral grooves are cut to correspond to the feed. In Fig. 8 a worm upon the shaft *e* acts upon a worm pinion to revolve the shaft e^1, and the worm at the other end of this shaft e^2 acts upon teeth around the base of the lever *i* on the stud 6. By this device the phonograph will be moved outward gradually, and the

line of indentations will be in a spiral corresponding to the continuous spiral groove in the plate *d*.

In Fig. 9 the shaft *e* is made with a fusee at p^1, and one end of a swinging arm connected to the phonograph takes against the same. The spirals of the fusee gradually move outward the phonograph, as the disk and shaft are revolved, and the line of indentions will be spirally the same as that made by the spiral 3.

In Fig. 10 the shaft *e* is provided with a screw pinion meshing with teeth upon a cam wheel 7. This gives the same movement to the phonograph as the spiral groove 3.

In Fig. 11 the guide groove 3 for the arm and pin *g* is upon a disk d^1 upon the shaft *e*, but the groove 3 occupies the same relative position upon the disk d^1 as the groove 4 upon the disk *d*, so that the phonograph is moved outwardly by the groove of the disk d^1, swinging both the arms *g* and *i* upon the vertical pivot 6.

Instead of the sheet of metal foil being upon the disk *d* it may be wrapped upon a cylinder *q*, as in Fig. 12. In this case the cylinder is upon a shaft e^1 revolved by the gearing at h^1, and upon said shaft there is a right and left hand screw at k^1, and there is a corresponding double spiral groove in the surface of the cylinder *q*. The phonograph is secured to a sliding shaft l^1, and said shaft is moved endwise back and forth by the screw k^1 acting upon an arm m^3 that is secured to the said shaft l^1. As the phonograph is moved in one direction the line of indentations is made spirally in the foil on the cylinder *q*, and when the arm m^2 reaches the end of the screw it will be moved in the other direction by the reverse screw thread, and the phonograph will make a second spiral line of indentations that will cross the first spiral line. This feature is especially available for a phonet where the surface of the cylinder *q* is formed of an electrotype or other copy of the phonogram, so that the words or sounds may be reproduced automatically and at intervals if desired. It is preferable to make use of a thin metal plate n^2, see Figs. 13 and 14, pivoted at one end and fitting within a longitudinal groove in the surface of the cylinder *q* for securing the edges of the metal foil and holding it securely upon said cylinder. The top of this plate n^2 is flush with the surface of the cylinder, and grooved to correspond with the grooves in the cylinder, so as not to interfere with the indenting point. A wire may replace this device, such wire being secured by arms at each end of the cylinder, and raised and lowered in and out of the groove by a cam or otherwise. I find that an interruption of one-eighth of an inch space where there is no recording is not detected by the ear.

The apparatus shown in Figs. 13 and 14 is similar to that shown in Fig. 12, except that the phonograph is stationary and the cylinder moves horizontally, and the shaft e^1 is only provided with a screw thread in one direction, hence the cylinder will have to be moved back by hand to bring it to place if desired to reproduce the sounds from the phonogram, or to position the phonograph if a new sheet of foil is to be indented after the first one has been removed. This is readily accomplished by raising the arm o^1 and its tooth from the screw k^1, which leaves the shaft e^1 and cylinder free to be moved back and forth. In Fig. 15 the phonograph is fitted to move horizontally instead of the cylinder *q*, as in Fig. 12, but the shaft e^1 is provided with a screw thread in one direction only, hence the phonograph has to be positioned by hand after the arm o^1 has been raised from the screw k^1. In Figs. 12 and 15 the phonograph can swing upon the shaft l^1 to raise the indenting point from the cylinder *q*, and allow for the removal or insertion of a sheet of foil, and there is a stop at 8 for adjusting the position of the phonograph when brought down to indent the foil.

In Figs. 13 and 14 the phonograph is upon an arm pivoted at 9, so that it can be swung horizontally away from the cylinder *q* for the purpose aforesaid, and the adjustable stop 8 is also provided.

Thus far I have described the "phonograph" or instrument upon which the sound vibrations act, and which instrument acts to indent the sheet of foil and produce the "phonogram" or record of such sound vibrations. Mechanism has also been described for presenting the sheet of foil to be indented by the phonograph.

I will now describe how the sounds are reproduced from the phonogram. If it is desired to reproduce the sounds from the phonogram in the same instrument in which the phonogram was produced it is only necessary that the indenting point *c* be made to traverse the line of indentations in the phonogram, and that a funnel-shaped mouth-piece, shown by dotted lines in Fig. 1, be added to the phonograph to aid in increasing the loudness and distinctness of the sound. The instrument in this form I term a "phonet."

In the instrument shown in Figs. 1, 2, 6, 7, 8, 9, 10, 11, 13, 14, and 15, the phonet requires to be positioned by hand, as before explained, in order that the point *c* may be placed at the beginning of the spiral line of indentations. As the point *c* passes from one indentation to the next, either by the foil being moved beneath said point, as in Figs. 1, 2, 6, 7, 8, 9, 10, 11, 13, and 14, or by the point moving over the foil, as in Figs. 12 and 15, the diaphragm *b* receives a movement corresponding to the depth of the indentations, and corresponding also with the same movement it received from the sound vibrations when making those indentations, hence air waves will be produced by the movement of the diaphragm that will make sounds by passing through the mouth-piece of the phonet that will be exactly the same as the sounds that acted upon the diaphragm of the phonograph.

The material upon which the record is made may be of metal foil, such as tin, iron, copper, lead, zinc, cadmium, or a foil made of composition of metals. Paper or other materials may be used, the same being coated with parafine or other hydrocarbons, waxes, gums, or lacs, and the sheet so prepared may itself be indented, or the material, say paper, may be made to pass through a bath of hot parafine and thence between scrapers. Thin metal foil is now placed on the material, and the sheet passed through rollers, which give it a beautiful smooth surface. The indentation can now be made in the foil, and the parafine or similar material, and the indenting point, does not become clogged with the parafine in consequence of the intervening foil. If the copper foil, or tin foil with copper surface is used, and a matrix of iron or steel made by electrotype deposit or otherwise upon the phonogram, such matrix may be hardened and used for impressing a sheet or roller of metal as hereafter mentioned; thereby the original phonogram can be reproduced indefinitely in metal that may be hardened and used for any reasonable length of time to utter the sentence or words or sounds phonetically.

I will now briefly describe some modifications in the construction and operation of the phonograph and phonet.

In Fig. 16 the indenting point *c* is upon a spring arm e^2, as in Figs. 1 and 2, but there are short sections of rubber tube e^8 at each side of the diaphragm *b* to dampen the diaphragm and prevent false vibrations. In Fig. 17, the rubber of the diaphragm acts against the outer end of the arm e^2 to increase the leverage and lessen the depth of indentations in the foil and allow of the record being made in less yielding material than tin foil. Fig. 18 shows a modification of the last-mentioned device, the pressure being applied to the arm e^2 between the indenting point and the support for the arm so as to increase the depth of the indentations. Fig. 19 shows the arm e^2 made as a lever with a spring. Fig. 20 shows the indenting point upon the center of a spring bar that is firmly held at each end; the bar is connected at its centre to the diaphragm *b* by a string or otherwise. Fig. 21 represents the diaphragm *b* as of concave form instead of flat. Fig. 22 shows the indenting point upon a spring secured to the diaphragm.

Fig. 23 shows a disk upon the spring e^2 of the indenting point; this disk is placed quite close to the diaphragm and is moved by the air as the diaphragm is vibrated, the disk being so close to the diaphragm that the two will vibrate together, as air cannot pass between or escape as rapidly as the vibrations take place.

Fig. 24 shows the diaphragm vibrated by electro-magnetism; in this case the diaphragm is to be of iron, and the power of the electro-magnet will be varied by a

rise and fall of electric current passing through the helix of the elecro-magnet; this rise and fall of electric tension is to be produced by the action of sound upon a diaphragm and connections in an electric circuit. Fig. 25 shows the method of vibrating the indenting spring and point by the direct action of an electro-magnet without the use of a diaphragm, the electric tension in the helix being varied by sound vibrations upon a diaphragm. Fig. 26 shows the spring arm e^2 connected to one end of a permanent magnet so as to highly magnetize the reproducing point; the foil should be of iron. When the point passes an indentation there will be less attraction than when passing no indentation; this will give good articulation free from the scraping noise of the point on the foil, for in this case it does not touch the foil, but is worked by magnetic attraction. Fig. 27 represents two instruments in connection with the cylinder q; in this case the phonet and the phonograph are separate. The phonograph records in the usual manner, but the phonet has its diaphragm set in motion by the rise and fall of the lever e^3. This reduces the scraping noise of the foil and acts by leverage, and a slight tension to move the diaphragm as the phonogram is moved beneath the point c. Fig. 28 shows an arrangement whereby four persons may speak simultaneously and have records made in separate parallel lines upon one cylinder, and the phonogram will reproduce the sounds the same as though it contained the record of but one voice. Fig. 29 shows a single phonograph adapted to receive the voices of three persons as in singing; the sounds made by the three voices are conveyed through flexible or other tubes to the diaphragm, and will be recorded in a single line of indentations. but when reproduced by the phonet the sounds uttered will correspond to the three voices.

In Fig. 30, the foil is sustained upon a hollow cylinder with a funnel-shaped end. The record is made upon the foil in the usual manner by the phonograph, excepting that holes are made entirely through the foil. A nozzle with a small opening is placed so that it will always be opposite the line of perforations as the cylinder is revolved. This nozzle is connected to a source of compressed air or other fluid, and every time a perforation comes opposite the nozzle, a puff of air passes into the cylinder and a sound is produced upon the principle of the siren. The nozzle may be placed on a spring to keep the end of the nozzle in contact with the line of perforations.

Fig. 31 shows the phonograph as made with a large chamber between the diaphragm and the mouth-piece; this is especially useful in collecting sound when the person speaking or the sound to be recorded is made several feet from the instrument. Fig. 32 shows a device whereby the indenting point may be dispensed with in the phonograph. The funnel forming the phonograph is made with a diaphragm at the larger end or mouth-piece, and a very small hole at the pointed end adjacent to the foil on the cylinder q; this foil should be very thin so that the indentations will be made by the direct action of the air waves as concentrated by the funnel without the interposition of the indenting point. Fig. 33 shows a phonet in which the phonogram or sound record has been made upon an endless belt; this is a convenient arrangement for toys, as the same may be made to imitate the bark of a dog or other noise made by an animal; and this belt may be of steel or other hard material that allows the same to be used for a long period of time.

Fig. 34 is a perspective view showing a double phonet, there being a spiral line of indentations on each side of the revolving disk d, one phonet coming into action as the other finishes; in this case the spirals should be in opposite directions, so that the disk continuing to revolve in the same direction moves one phonet from the center outwards, and then the other phonet is connected and moved back towards the center; this may be used as a toy.

Fig. 35 represents a phonet in which the phonogram containing a sentence, speech, words, or other sound record is upon a belt or strip wound upon a reel; this belt is drawn along gradually and wound upon the second roller by any suitable mechanism, and as the phonogram is thus moved it actuates the

phonet c, b. Fig. 36 shows a phonograph or phonet similar to that shown in Fig. 12, the cylinder q is revolved, but remains in one position, and the phonograph or phonet is movable back and forth over the cylinder. In this instance the arm m^2 is extended beyond the screw k^1, and passes beneath the inclined spring guide m^5, when the screw is carrying the arm and phonograph towards the right: as the arm m^2 passes from beneath the end of the guide m^5 it is no longer held to the screw, and the arm m^2 and phonet are lifted by the guide m^5 as the springs m^3 draws the shaft, phonograph, and arm, along to the place of beginning, at which place the arm m^2 drops off the end of the inclined guide m^5 into the thread of the screw, and as this revolves it carries the arm along beneath the guide m^5 as before. Fig. 37 represents the phonograph or phonet upon a pivoted arm, so that it may swing across or at right angles to the line of movement of the intended material or phonogram. In this case the line of indentations may be lengthwise of the belt, or across the same in the arc of a circle. Fig. 38 shows a phonograph similar to that shown in Fig. 31, except that the sound chamber is of a different shape.

Fig. 39 shows a mouth-piece with an orifice of soft rubber to fit the mouth or the lips of the person speaking, so that all sound waves will be confined to the chamber and diaphragm. Fig. 40 shows the mouth-piece of the phonograph made with cross slots with irregular edges. Fig. 41 shows the mouth-piece as perforated with numerous holes. Fig. 42 shows but one opening in the mouth-piece; the edges of this are irregular. These irregular edges reinforce the hissing sounds, and cause a more perfect phonogram to be produced. Fig. 43 represents a mouth-piece of mica with a central opening protected at its edges by a wooden ring. In Fig. 44 the diaphragm b is of wire gauze with a backing of paper connected to it by any suitable cement, and there is a ring of stiff paper at the edges of the gauze disk to strengthen it. Fig. 45 represents a diaphragm b of parchment or similar material stretched tightly within the frame b^6 by cords and screws. The cords may be of different lengths and tension, and respond to and reinforce certain sounds. Fig. 46 shows a mouth-piece for the phonet made in imitation of the human mouth. Fig. 47 represents the body portion of the phonograph or phonet made triangular, and the diaphragm is of corresponding shape. Fig. 48 represents three cylinders, each provided with a phonograph or phonet; this is useful in recording and reproducing three-part singing or music. Fig. 49 represents a phonet made as a tube, with flaring or trumpet-shaped ends, and with two diaphragms 15, 16, placed crosswise of the tube so as to form an air chamber. There is a third diaphragm b, which is vibrated by the movement of the reproducing point c, and said diaphragm gives motion to the air in the chamber, and vibrates the diaphragms 15, 16, which latter produce air waves, and the sounds issuing from the two trumpet-shaped ends will blend and increase the volume of sound. Fig. 50 represents a device whereby deep indentations are made in the metal foil. Two diaphragms are employed, the first (b^2) is vibrated by the sound vibrations, and controls a valve b^7 in a tube connected with a source of compressed air or other fluid; this valve b^7 allows more or less air to pass to the diaphragm b, according to the vibration of the diaphragm b^2, hence the diaphragm b will vibrate in harmony with the diaphragm b^2, but it will be acted upon by greater force, and consequently the indentations will be deeper in the foil than if the diaphragm b was acted upon simply by the sound vibrations of the voice. Figs. 51 and 52 represent a device that may be used with a phonet to increase the loudness of the sounds reproduced. The sound vibrations from the phonet are conducted by a tube shown by dotted lines in Fig. 51, to the diaphragm b^2 that controls a valve b^7 in a tube connected with a reservoir of air or other fluid under pressure, and the air as it escapes by the valve passes into the trumpet-shaped end of the tube, and produces sounds that are very loud and clear, and are a reproduction of the sounds resulting from the use of one of the phonets before described. This same apparatus may be used to reproduce with louder utterances a person's voice, the sound from the voice being used to vibrate the diaphragm b^2, and thereby regulate the air waves escaping from the valve b^7 into the trumpet. Fig. 53 shows the speaker's head within a box or case; in this instance nearly all

the sound vibrations act upon the diaphragm. Figs. 54 and 55 illustrate how the movements of the lips in speaking may be recorded and reproduced. In this instance, a lever applied to the diaphragm carries the indenting point *c*, Fig. 55, and the end of this lever is placed in the mouth of the speaker, and the movement of the lips regulates the indentations in the foil. A similar apparatus shown in Fig. 54 within a case is connected to the movable lips of a mask, so that these lips open and close as in articulation, at the same time that the sound vibrations are given by the phonogram to the phonet. Fig. 56 represents a toy phonet in which the phonogram strip 35 is secured at one end to a cylinder upon which it is wound. By pulling upon the strip it is unwound, and a rubber cord 37 is wound upon the shaft of the cylinder. When the hand is removed from the indented strip, the rubber cord rotates the shaft and winds up the phonograph upon the cylinder, and the sounds are reproduced in the phonet by the phonogram acting upon a point and diaphragm *a*. The movement of the shaft is regulated by the fan, worm, and pinion 38. In Fig. 57, the cylinder for moving the phonogram strip is shown as provided with pins that enter holes in the edges of the strip; this causes the strip to be fed along very regular. In Fig. 58, the cylinder with pins is shown as made with heads to act as guides for the strip. Fig. 59 shows a re-indenting device for amplifying or increasing the size of the indentations. There are two rollers, one of which a^4 travels faster than the other a^3, and there is a lever 40 pivoted at 41, and provided with a point *c* for each cylinder. One point follows the indentations in the cylinder a^4, and the other rests upon a^4, and as this travels the fastest, the indentations made therein will be longer and also deeper by the point being at the outer end of the lever. In Fig. 60, one roller 42 of the pair is made of hardened metal with the sound record in relief. This is obtained by electrotype or other process from an iron foil or other metal phonogram, and this roller is used to indent strips or sheets of foil or rollers to produce copies that can be used with the phonet. Fig. 61 represents a roller 42 of hardened metal with the record in relief, and arranged so as to knurl or indent the phonogram in a roller 43 of soft metal that is to be pressed against the roller 42 by a screw or other suitable means. The cylinder having a spiral groove in its surface may be made by placing the mould shown in Fig. 62 around a cylinder or shaft, and filling the space between the cylinder and mold with plaster of Paris or other suitable material. The mold is of metal with a screw or spiral rib projecting therefrom, and it is made in two parts and hinged so that it can easily be removed when the plaster of Paris is dry. For amusement or instruction, the phonograph is capable of extended use; for instance, a revolving cylinder, see Fig. 63, containing rows of indentations representing the letters of the alphabet, and provided with keys containing corresponding letters, can be used in teaching the alphabet, and sentences, speeches, and other matter can be spoken by the phonet, and repeated by the learner without the eyesight being called into use. Clocks may be provided with phonogram cylinders or wheels to call off the hours, to give alarms, &c. The phonogram may be upon a strip, sheet, belt, or roller, and it can be of a dog's bark, a rooster's crow, a bird's song, a horse's neigh, and these can be used in toy animals with a simple phonet for reproducing the sound. In copying phonograms, or making duplicates, an original phonogram may receive a deposit of copper or iron in a plating bath; and, if of iron, may be carbonized to convert it into steel and hardened, and then the same should be backed up with type metal, and use for impressing strips or pieces of metal.

A bed of gutta percha, or similar material, may be used to sustain the sheet metal while being pressed. Numerous copies of the original phonogram can thus be reproduced. A plaster cast can be used for producing a copy by pressure. The governor to regulate the speed of the instrument may be made of a pendulum weight 61, see Fig. 64, hung at the lower end of a rod that is provided with an universal joint at 62, and the upper end of the rod is moved around by a crank 63 that is revolved by the train of gearing. As the speed increases the weight will describe a circle of larger diameter, and thereby increase the resistance. The universal joint may be displaced by a spring wire, Fig. 65, that allows of the

movement. A magnet 64 upon the crank arm 63, Fig. 66, may be use to revolve the pendulum by attracting an armature at the upper end of the pendulum rod, and thereby avoid the friction resulting from the contact of the surfaces of the pendulum rod with the crank. In Fig. 67 the diaphragm *b* is represented as connected to pair of delicate piston valves within a tube 68 that has three ports; one 69, is connected to a reservoir of compressed air, the others, 70 and 71, are connected to a chamber 72 at opposite sides of a diaphragm, so as to vibrate the same in harmony with the diaphragm *b*, but there will be greater amplitude given to the same by the pressure of the air, and by a connection to the phonet diaphragm b^2 the sound produced will be greatly increased.

What I claim as my Invention is,—

First. The combination with the diaphragm and point of a flat receiving surface and means for revolving the receiving surface, and causing the point to follow a volute or spiral line, substantially as represented in Figs. 1, 2, 6, 7, 8, 9, 10, and 34.

Second. The combination with the revolving plate phonograph or phonet of a propelling weight or spring and a governor to regulate the speed, and ensure uniformity of movement, substantially as set forth.

Third. A revolving disk provided with a clamping frame to secure the foil or other material in combination with the swinging arm, diaphragm, and point, substantially as specified.

Fourth. In a phonograph or phonet, a spring introduced between the diaphragm and the point, substantially as set forth and shown in Figs. 16, 17, 18, 19, 22, and 26.

Fifth. In a phonograph or phonet, a rubber spring, or similar device, to dampen the vibration of the diaphragm, and prevent false vibrations, as set forth and shown in Figs. 16 and 21.

Sixth. The combination with the diaphragm in a phonograph or phonet apparatus of a lever to modify the relative action of the diaphragm and point, substantially as described, as shown in Figs. 17, 18, 27.

Seventh. The combination with the diaphragm and point of a permanent or electromagnet, substantially as described and represented in Figs. 24, 25, 26.

Eighth. The method of recording and reproducing two or more sounds or speeches simultaneously, substantially as described, and as illustrated by Figs. 28, 29, and 48.

Ninth. A phonet composed of a perforated sirene and a jet tube, substantially as described, and represented in Fig. 30.

Tenth. The mechanism for producing a phonogram, and employing the same in a phonet, substantially as described, and illustrated in Figs. 32, 33, 35, 36, and 37.

Eleventh. The combination with the phonograph, diaphragm, and point of a sound chamber, substantially as described, and illustrated in Figs. 31, 38, 39, and 53.

Twelfth. The diaphragm and mouth-pieces for a speaking phonograph, substantially as described, and as illustrated in Figs. 41, 42, 43, 44, 45, and 46.

Thirteenth. The combination with a diaphragm and its point of two diaphragms for the purposes, and substantially as shown in Figure 49.

Fourteenth. The combination with a diaphragm and valve actuated by sound vibrations a source of compressed fluid and a trumpet, as in Figs. 51, 52, or a phonograph as in Fig. 50, substantially as set forth.

Fifteenth. The combination of two diaphragms with a valve and a source of compressed fluid, as represented in Fig. 67, for increasing the volume of the voice or other sound, as set forth.

Sixteenth. The combination with two or more phonograms of phonet keys for selecting letters or utterances as described, and illustrated in Fig. 63.

Seventeenth. The means for duplicating or reproducing phonograms from an original phonogram, substantially as set forth.

Eighteenth. The combination with the phonograph or phonet of the revolving

crank and pendulum governor, substantially as described and shown in Figs. 64, 65, 66.

Nineteenth. The combination with the phonograph of a lever moved by the lips, and of a lever and phonet to move the lips of a mask, substantially as described, and illustrated by Figs. 53 and 54.

Twentieth. The combination with a phonogram of a clock movement or toy and a phonet for reproducing sounds for clocks or toys, substantially as set forth.

In witness whereof, I, the said Thomas Alva Edison, have hereunto set my hand and seal this 17 day of September, A.D. 1878.

THOMAS ALVA EDISON. (L.S.)

Witnesses,
CHAS. H. SMITH,
76, Chambers St., New York.
HAROLD SERRELL, 76, Chambers St., New York.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[41. 9226—250—4 1906.]

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Fig. 1

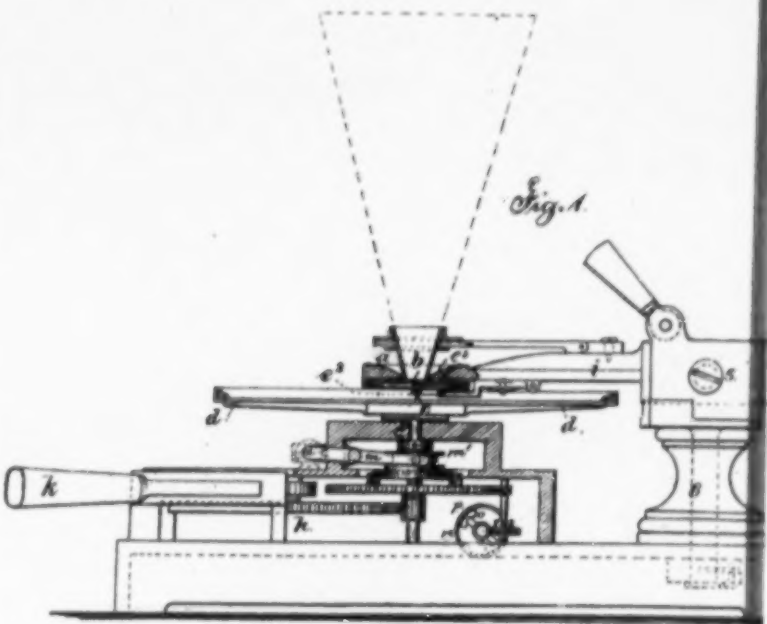
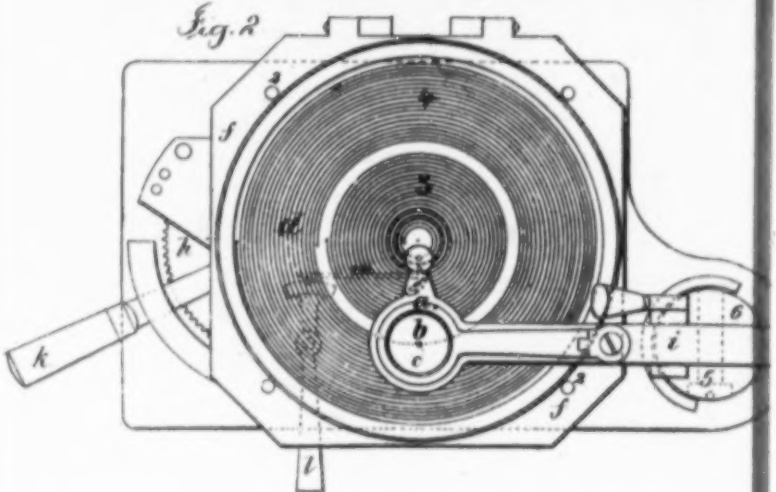


Fig. 2



4 SHEETS]
SHEET 1.

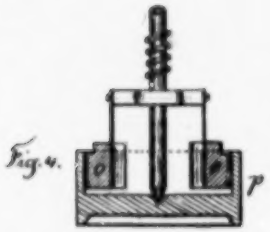
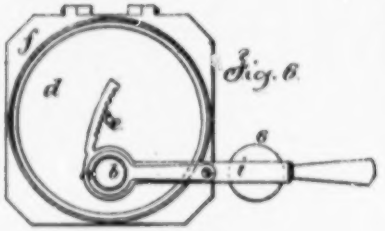


Fig. 4.



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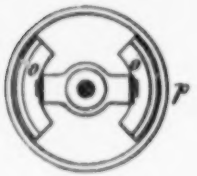


Fig. 3.

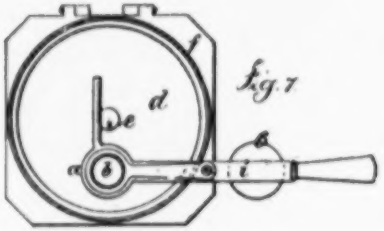
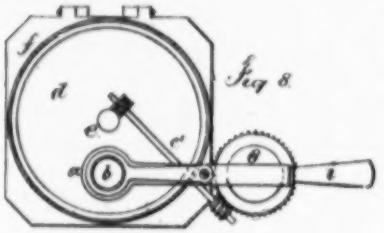


Fig. 7.

Fig. 5.



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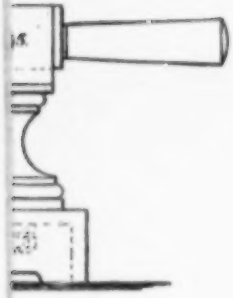

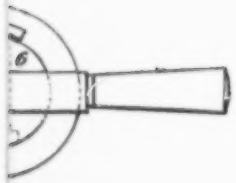

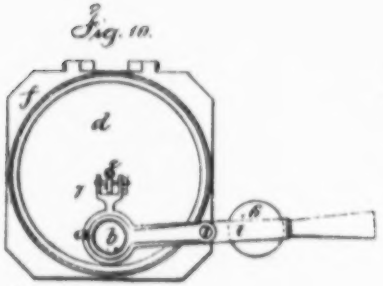

Fig. 10.

Fig. 9.

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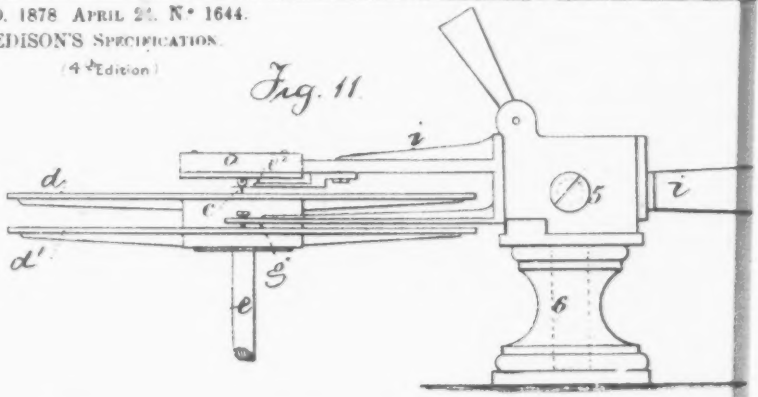
Fig. 11.



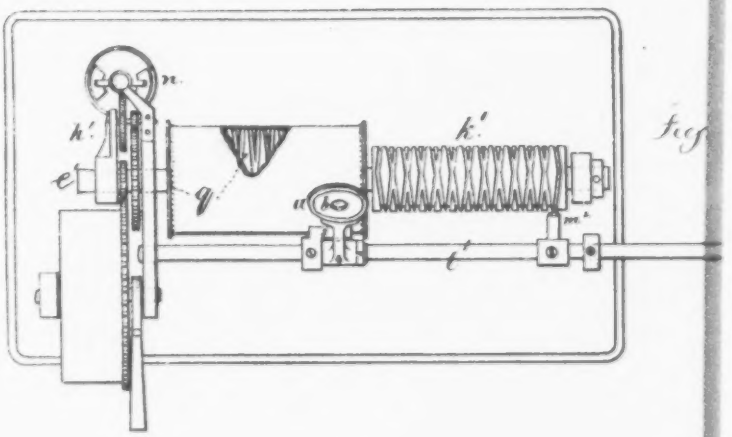
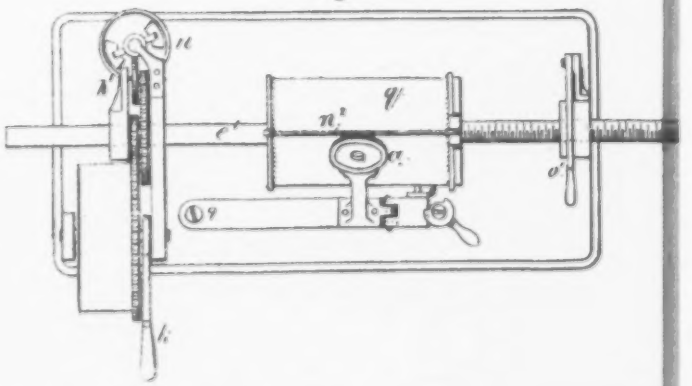


Fig. 13.



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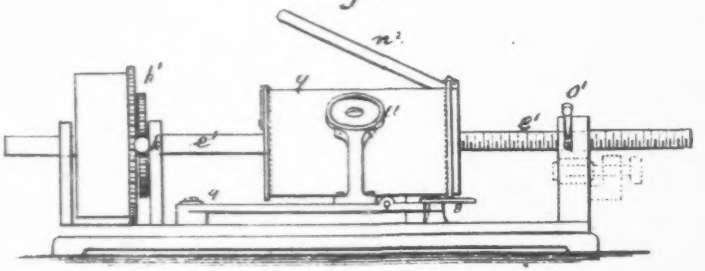


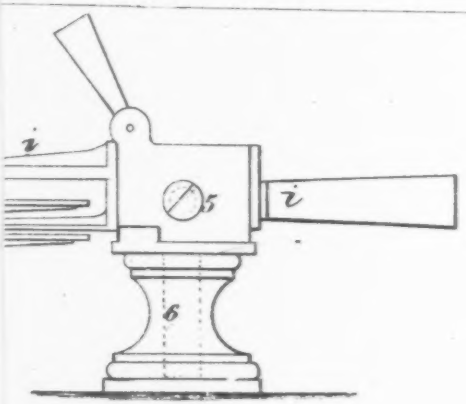
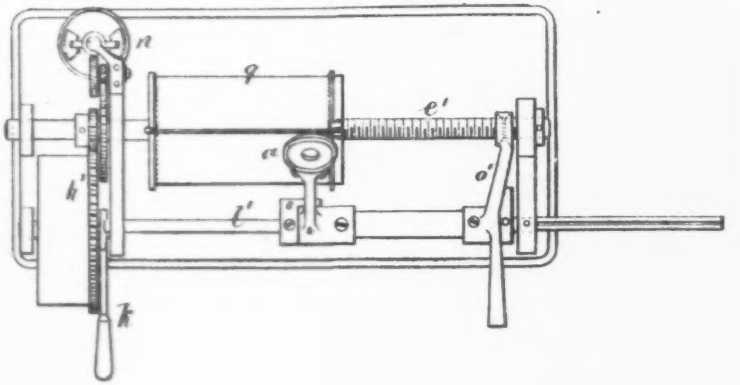


Fig. 15



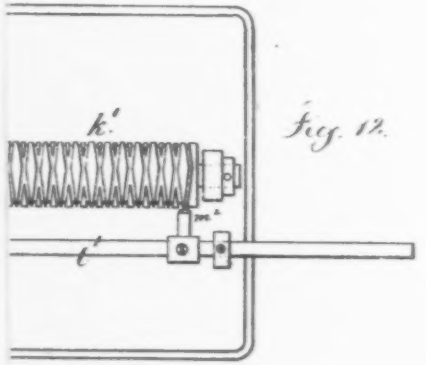
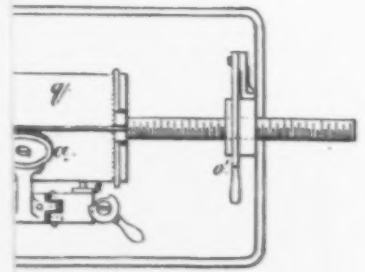


Fig. 12.

Fig. 13.



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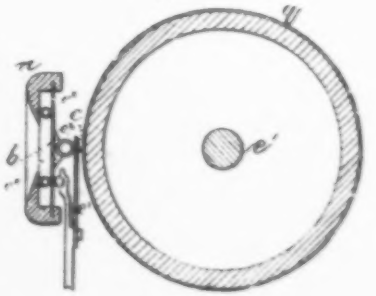

Fig. 17.

Fig. 18.

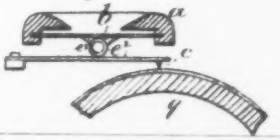

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Fig. 20

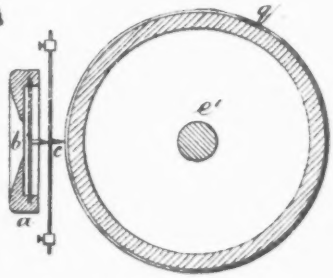


Fig. 19.

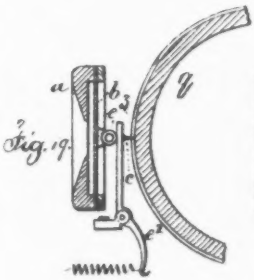


Fig. 21

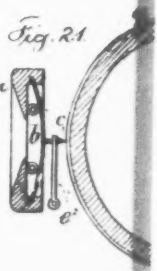
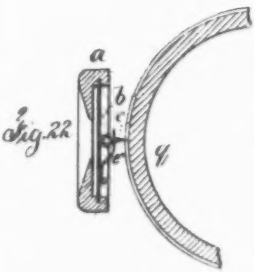


Fig. 22



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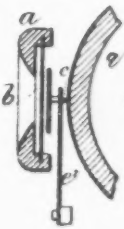
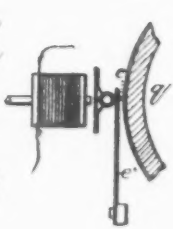


Fig 24



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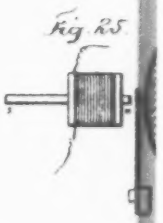


Fig. 26.

Fig. 27

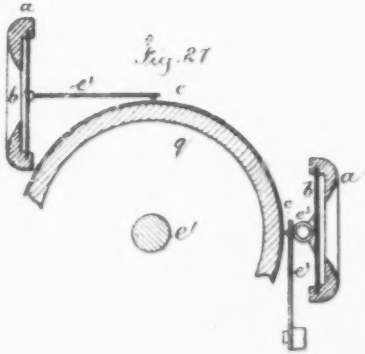


Fig 28.

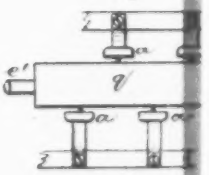


Fig. 29

4 SHEETS
SHEET 3

Fig. 20

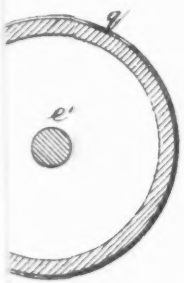


Fig. 21

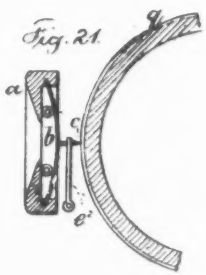


Fig. 30

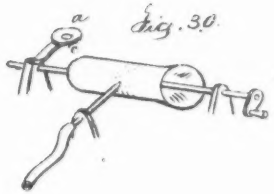


Fig 31

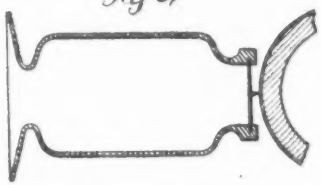


Fig. 32

Fig. 33

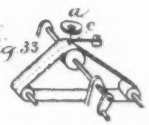


Fig. 34.

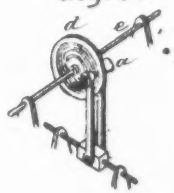


Fig. 35

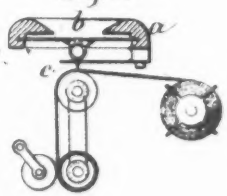
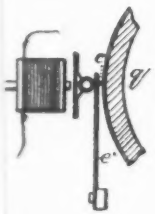


Fig. 24



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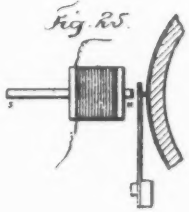

Fig. 36

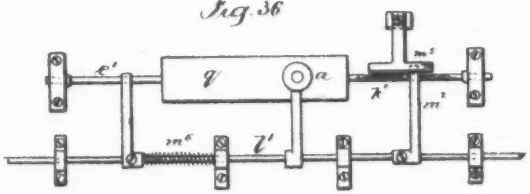

Fig. 37

Fig. 43.

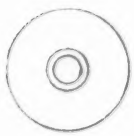

Fig. 38

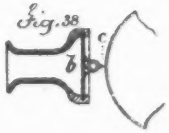

Fig. 39

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Fig 28.

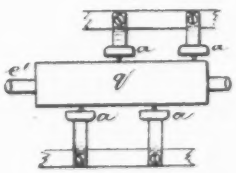

Fig. 29.

Fig 44

Fig 45

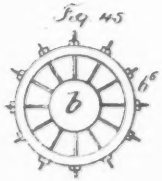

Fig. 46.

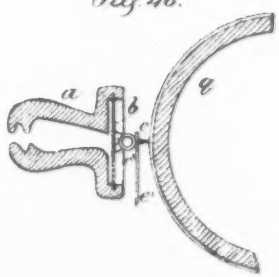

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Fig. 48

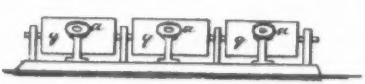


Fig. 49

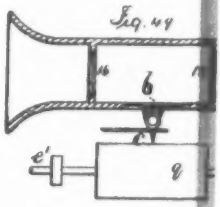


Fig. 47.

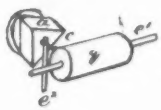


Fig. 50.

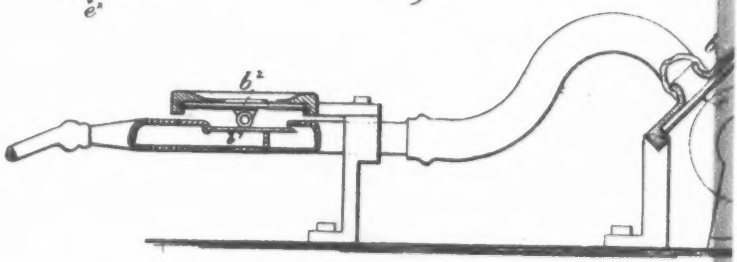


Fig. 51.

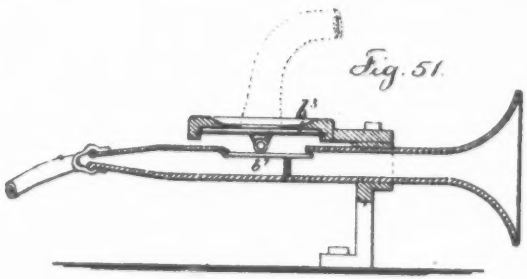
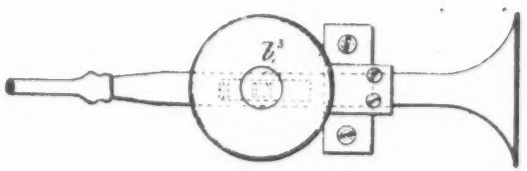


Fig. 52.



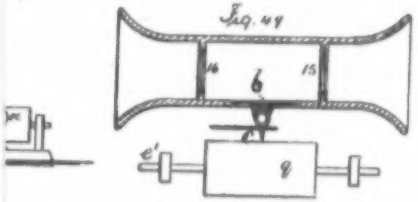


Fig. 49

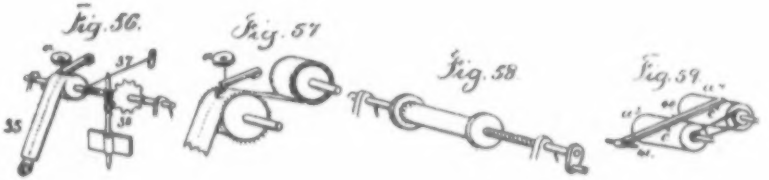


Fig. 56.
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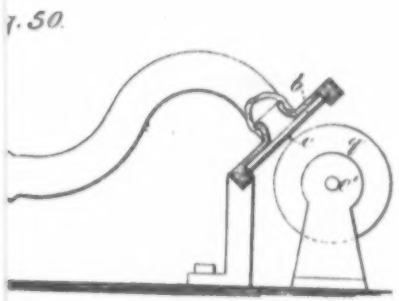
Fig. 50.

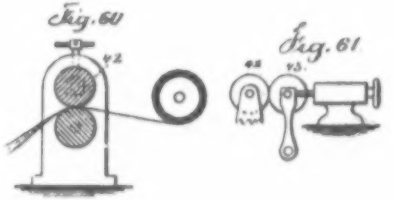
Fig. 60
Fig. 61

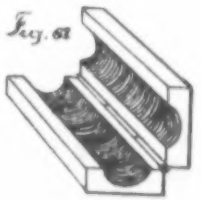
Fig. 62

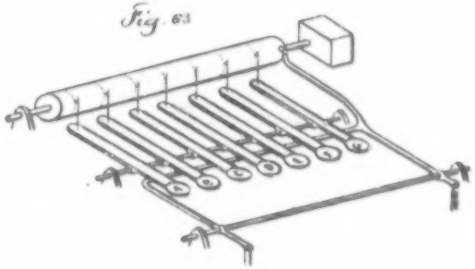
Fig. 63

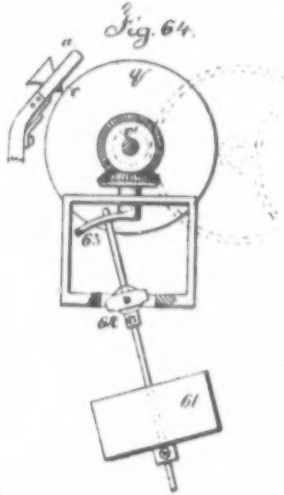
Fig. 64.

Fig. 51.

Fig. 53

Fig. 54.

Fig. 55

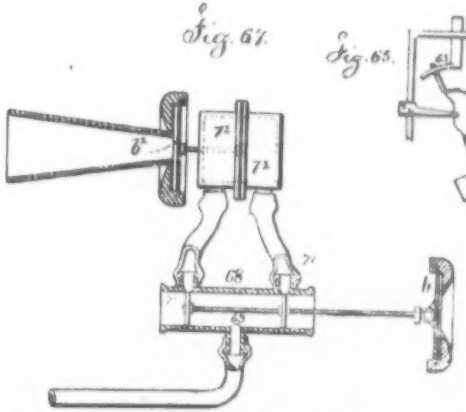
Fig. 67.

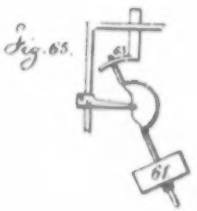
Fig. 65.

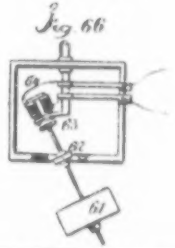
Fig. 66

This Specification was, upon the 7th day of October 1890, amended under Sections 18 to 21 of the Patents, Designs, and Trade Marks Act, 1883.

[*The Amendments are shown in crased and italic type.*]

N° 6027*

A.D. 1886

COMPLETE SPECIFICATION (AMENDED).

[*Communicated from abroad by The Volta Graphophone Company, of Alexandria, Virginia, in the United States of America.*]

Improvements in and Apparatus for Recording and Reproducing Speech and other Sounds

I, JAMES YATE JOHNSON of 47 Lincolns Inn Fields in the County of Middlesex Gentleman do hereby declare the nature of this Invention (which has been communicated to me from abroad by the Volta Graphophone Company of Alexandria Virginia in the United States of America and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This Invention relates to the formation in a solid substance of elevations and depressions or other inequalities corresponding more or less perfectly to the forms of sound vibrations and the reproduction by means of such inequalities of the sounds represented by them.

The invention consists first in the formation of the record or "Phonogram" as it has been called by means of a cutting style which is vibrated by the sound waves or sonorous vibration to be recorded. The vibrations may be impressed upon the style directly by the impact of the sound waves upon some device mechanically connected with or carried by the cutting style or its support or indirectly through the action of an electric current or other suitable vibratory medium.

Heretofore a large number of contrivances have been devised for converting electrical impulses into mechanical vibrations and they could of course be used for vibrating the cutting style otherwise they have no relation to this part of the present invention the essential new feature of which is the removal of material to form the record by a cutting, gouging or graving action of the vibrating style.

Heretofore the vibrating style has, as in Edison's well known Phonograph, simply ~~indented~~ *indented* the recording material. It has been proposed to cut the record in the edge of a strip of metal or other solid material by vibrating the strip in contact with the cutting edges of a rotary disc cutter but this proposal is essentially different from this Invention: the new mode being applicable to cutting the record upon all sorts of surfaces and not upon strips only. Under this part of the

Invention are included the vibratory cutting style as a new device in a sound recorder, and a combination of the same with other devices; also the cut or engraved record itself.

In this new or improved form of Record not only may a larger number of words or sounds be recorded in a given surface than has been practicable with the indented records heretofore in use but the recorded vibrations are also sharper and better defined—It is found that an indenting style smooths over the crests of the larger elevations and also rubs out some of the finer ones.

The Invention consists secondly in engraving or cutting the Records in a ~~wavy~~ *waxy* or amorphous and slightly cohesive substance. Preferably a compound of beeswax and paraffine (the latter in excess) is employed—This compound has no tendency to clog the style but is readily removed thereby in chips or shavings. This part of the Invention also ~~consists in~~ *includes* a recording material composed of a wax or waxy surface on a paper or pastboard foundation.

Heretofore it has been proposed to use soft paper saturated or coated with paraffine as the material for recording by the indenting method but its use does not appear to have been successful and an outer layer of tin foil was therefore employed to receive the indentations.

The Invention consists ~~thirdly~~ *also* in cutting or engraving the record in the form of a groove with sloping walls the sound waves being represented by elevations and depressions at the bottom of the groove or otherwise. The advantage of this form of record is that it forms an efficient guide to the reproducing style.

~~The invention consists fourthly in loosely mounting~~ The reproducing style *should be mounted* so that it can readily be guided by the record. This may be accomplished in different ways as for example by mounting the head of the reproducing instrument upon a joint which admits of a lateral movement, or the style may be so mounted as to be capable of a lateral movement independently of a diaphragm and other parts of the reproducer—By this latter arrangement the style can accommodate itself to the record without having to put in motion the larger mass of the head of the reproducer. It therefore responds more quickly—Both arrangements will be illustrated.

In order to allow the reproducing style the greatest freedom of side movement while insuring its return to a central position and without impairing to a serious extent its rigidity in other directions a comparatively broad and thin strip of spring metal placed on edge is connected with or forms part of the reproducing style—Such a strip is very flexible to side pressure but comparatively rigid to other pressures. The strip is fastened to the diaphragm or to the device upon which it is desired to impress the vibrations or it is otherwise hinged so that it can impress vibrations on said device, or said strip may be rigidly connected with the frame of the reproducer and the style be flexibly connected with the outer end of the strip.

Preferably the reproducing style is fastened to the end of a thin metal strip parallel with the width thereof so as to form a hammer like arrangement the style being the hammer head. It is a pin or wire several times as thick as the metal strip. The vibrations are transmitted through the hammer head the actual strip being attached to a spring or it may be otherwise hinged to the frame of the reproducer.

The reproducing style mounted as just explained, is specially adapted for use in connection with a Record in the form of a groove with sloping walls and this combination is specially claimed but it may also be usefully employed in connection with other forms of record.

~~The invention consists fifthly in~~ Reproducing *may be done* directly from the wax record. It is found that such a record has sufficient strength to withstand the rubbing action of the reproducing style so that a considerable number of reproductions can be obtained from it. The smoothness of the wax gives it a great advantage in this respect—It is believed that heretofore no one has reproduced sounds from a wax record by rubbing a style or reproducer over it.

The ~~Invention consists sixthly in transmitting the~~ vibrations of the reproducing style *may be transmitted* through a diaphragm, a *or* plate or other body of hard rubber. This material is found to give out purer sounds, the minute foreign vibrations being absorbed to a greater extent than with mica or metal, either of which and other materials also can under proper conditions be used with intelligible results.

The ~~Invention consists seventhly in cutting the~~ sound record *may be cut* in a fusible material the waxy compound before referred to for example and then ~~melting~~ the surface *be melted* slightly so as to remove any roughness left by the cutting style; these roughnesses are altogether outside of the sound vibrations and give rise in reproducing, to scraping noises which interfere with the intelligibility of the sounds reproduced. These scraping noises are greater with some other modes of reproducing which will form the subject of other Patents, than they are with a rubbing style, but even with the latter the additional smoothness given to the surface by the partial fusion has some advantage.

The invention consists ~~eighthly~~ *also* in a sound recorder having a cutting or graving style which is held by elastic or yielding pressure against the surface on which the record is to be made. The object is to enable the vibratory graver or cutting style to ride over instead of ploughing through any elevations on the recording surface—The depth to which the point of the cutting style is embedded in the Record affects the amplitude of the style's vibration By this Improvement the depth is kept uniform notwithstanding any slight unevenness of the recording surface.

The whole pressure of the Recorder may be borne by the style but there are advantages in combining with the recorder a rest which bears upon the recording surface or Tablet as it is called in this Specification and relieves the style of the greater part of the weight. The use of the rest enables a shallower groove to be cut effectively and also a lighter and more sensitive mounting of the style to be made The style projects beyond the rest. To regulate the depth of cut the rest is made adjustable.

In order to secure the most sensitive mounting for the recording style the latter is made from a short piece of wire and is attached directly to a diaphragm so as to be carried thereby; the means preferably employed being a screw thread on the style a nut of hard rubber engaging the same and a disk or washer of hard rubber between which and the nut the diaphragm is clamped.

The Invention consists ~~ninthly~~ *also* in having the recorder of whatever description or the producer or both rest against the tablet or recording material by gravity.

~~The Invention consists tenthly in combining~~ *There may be combined* with a sound recorder or reproducer of any suitable description, a tube or hollow standard on which the recorder or reproducer is mounted and through which the sound waves are conveyed. This ~~part of the Invention also consists in supporting this~~ hollow standard *may be supported* on a hinge and ~~having~~ *have* a sound conveying tube communicate with the interior thereof through the hinge—~~Also in the use of a~~ *There may also be used a* double ear piece for listening to the reproduced sounds and ~~of~~ a stop cock for modifying the loudness of these sounds. The double ear piece is somewhat similar to a Stethoscope —It consists of two elastic and flexible hollow branches provided each with a cup fastened to the branch by a ball and socket joint The cups fit over the ears and are held against the head by the elasticity of the branches the universal joint allowing each cup to adjust itself to the head of the user. The stop cock is placed in the sound conveying tube between the reproducer and the ear of the listener so that by partially closing the same more or less of the sounds can be cut off as desired. Where more than one person is listening each of the sound conveyors may have its own stop cock.

~~The Invention consists eleventhly in combining~~ *Combined* with the Recorder *there may be* a mouth piece so shaped as to include the nose of the user. It is found desirable to concentrate the sound waves as much as possible upon the recording instrument or style and if an ordinary mouth piece be used the sound reproduced in the Record is imperfect in the nasal elements and is somewhat like the speech of a person with a cold in his head. By the use of the improved mouthpiece this disagreeable quality of the reproduced sound is avoided The sound conveyor or concentrator

preferably used consists of a flowing mouthpiece of elliptical or oval section which covers the nose of the user and a tapering tube forming a continuation thereof which serves to amplify and reinforce the sound waves It is found that the longer this tube is within certain limits the greater its reinforcement of the sound waves but that a too great length gives a hollow effect as when words are spoken into an empty barrel.

For the sake of lightness it is preferable to make the mouthpiece and tube of thin sheets of hard rubber or of paper or the like material—Metal mouth pieces and tubes have also been used with good effect.

~~The Invention consists twelfthly in combining~~ With the reproducer *may be combined* a brush which bears upon the tablet and sweeps the record in advance of the reproducing style. Where the record is cut in wax the little shavings or chips are apt to cling to the record and have to be brushed off before reproducing—This can be done by hand, but it is not desirable to rely wholly upon hand brushing as too much care would have to be exercised to ensure that no particles adhere. The record is also liable to collect dust.

The Invention consists ~~thirteenthly~~ *also* in combining, with a recording and reproducing apparatus, in which the record is formed on the face of a disc in a volute or spiral by cutting or otherwise by any known or suitable means mechanism for giving to said disc an uniform surface speed under the recorder.

Heretofore when the Record was formed on the face of a disc the latter has been given an uniform rotation so that the same number of words were recorded in the outermost circle as in the smaller inner ones. By giving to the disc an uniform surface speed under the Recorder or by making the times of each rotation inversely proportional to the distance of the Recorder from the centre of the disc, the record of any given word or sound will be of the same length at whatever part of the disc it may be, and in this way it is possible considerably to increase the number of words or sounds on a given area.

~~The Invention consists fourteenthly in a~~ *The* recording tablet is *preferably* composed of a hollow Cylinder or tube of paper or other suitable material coated with wax or wax like composition, preferably a compound or mixture of beeswax and paraffin—The Record is cut in the coating. The advantages of this form of tablet are that it may be very light while having sufficient stiffness to retain its form and avoid the danger of cracking the coating, it is compact and adapted for transmission through the mails or otherwise, the recording surface is continuous and it can very readily be placed on and removed from the holder by which it is supported and rotated in recording and reproducing.

~~The Invention consists fifteenthly in~~ *A* new tablet holding mechanism.—~~The tablet holder~~ is made in the form of a Cylinder over which the tubular tablet can be forced or slipped and from which it can be removed as desired. This Cylinder may be solid but for lightness it is preferably made hollow—It is of metal or may be of other solid material. It is journalled in bearings and is provided with a Crank or other means for rotating the same.

In order to support the tablet holder in the most solid manner it is provided with a journal at each end and these journals and bearings are constructed to prevent end motion It is most detachable from its support at one or both ends in order to permit the placing and removal of the tablet—It will be understood that any ordinary or suitable means may be used for this purpose but it is preferred to use the means next to be described.

To facilitate the placing of the tablet on the holder and its removal therefrom and to avoid the removal of the tablet holder from the machine frame when this operation is performed a ball journal fitting in a cup or socket bearing, is employed at one end the other end being made detachable from the machine frame so that the holder can readily be tipped up and held in that position while placing or removing the tablet. The ball journal and socket bearing prevent end motion of the tablet holder.

With the object of further facilitating the placing and removal of the tablet the detachable end of the tablet holder is held down by means of a catch or other device which can readily be released and a spring is combined with the holder in such a way as to raise the detachable end thereof when the catch is released.

The journal at the detachable end of the Tablet holder instead of resting directly upon the machine frame or a bearing attached thereto, is provided with a box or sleeve which fits over the journal and forms the bearing therefore. This box or sleeve remains on the journal when it is detached and protects it from dirt as well as prevents the lubricant on the journal from soiling the hands of the person using the machine. The spring for raising the holder acts upon this box (a rod being interposed) and the journal is relieved of its pressure. Another advantage which the use of this box or sleeve gives is that if the two bearings in the machine frame are not precisely in line the box or sleeve may adjust itself properly without joining the journal. The very slight space which always intervenes when two separate pieces rest in contact will suffice to compensate for the very slight irregularity in alignement which a careful workman would leave.

~~The Invention consists sixteenthly in~~ *There is also provided* new or improved mechanism for supporting the recorder or reproducer and moving it across the face of the tablet (radially if a disc, or longitudinally if a Cylinder) so that by the combined translating motion of the Recorder or reproducer and the rotation of the tablet the recorder traces, and the Reproducer follows a spiral line on the tablet. This general form of instrument is known as well as that in which the tablet (disc or Cylinder) has a combined rotatory and translatory movement and *these* improvements ~~constituting the present Invention~~ are mostly applicable to both forms; but some of them ~~as those of this sixteenth part of the Invention~~ are limited to the form in which the recorder and reproducer have a translatory movement by means of a feed screw. To enable the Recorder and reproducer to be readily applied to and removed from the screw so that one screw can be used for both instruments, they are each provided with a divided or partial nut which engages the screw. To prevent the instrument from being disengaged accidentally a guard is or may be provided which can be slipped under the screw when the instrument is in place or be withdrawn when it is desired to remove it. Both the reproducer and the Recorder may have such a guard but practically it is more important for the Recorder.

Instead of having the recorder and reproducer mounted upon a slide moving in ways or guides and connected with a screw for moving the same, they are mounted on a carrier which is not only engaged by said screw but supported by the same so as to be moveable lengthwise of the screw and capable also of turning on it as on a journal. Thus devices heretofore considered necessary are dispensed with and a movement of the recorder or reproducer towards and away from the tablet is provided for.

The invention consists ~~seventeenthly~~ *also* in mechanism whereby the operation of the machine can be stopped temporarily. To enable this to be effected instantly, without stopping the main shaft of the machine, mechanism is provided for putting the feed screw out of action and at the same time automatically lifting the instrument clear of the record—Heretofore it has been necessary to stop the machine entirely. This is not desirable because in stopping and restarting the machine a difference in speed which appears on the record or in the sounds reproduced is almost certainly made, particularly where a fly wheel is used to give steadiness of motion.

This part of the Invention also comprises means whereby a word or sentence or a paragraph can readily be repeated when desired. To effect this a reversing as well as a stop mechanism is employed so that by bringing said mechanism into action the motion of the reproducer is reversed and the instrument is brought back to the beginning of the part to be repeated being meanwhile lifted clear of the record which continues or may continue to revolve in the same direction at an uniform speed.

~~The invention further comprises certain special constructions combinations and arrangements of parts as hereinafter set forth.~~

Having now explained the principle of the Invention, the manner in which the same is or may be applied will now be explained with reference to the accompanying drawings which make part of this Specification.

Fig. 1 is a plan view of an apparatus constructed in accordance with the Invention arranged for recording sound upon the face of a disc. Figures 2 and 3 respectively a front elevation and cross section of the same—Figure 4 a view in section and elevation of the recorder. Figures 5 and 6 views on an enlarged scale of the graver or cutting style Figures 7 and 8 views in elevation and section respectively of the Reproducer Figures 9 and 10 similar views of another form of reproducer and Figure 11 an elevation of the sound conveying tube for use with the reproducer.

Figures 12—17 represent a modified form of the disc apparatus Figure 12 being a back view partly in section Figure 13 a plan partly in section Figure 14 an edge view partly in section. Figures 15 and 16 views in elevation and section of the Recorder and Figure 17 an edge view of a friction clamp making part of the apparatus. Figures 18 and 19 are plan and longitudinal sections respectively of a form of apparatus also constructed in accordance with the invention in which the Record is made on a strip and figure 20 a plan partly in section of the reproducer for use with such apparatus. Figure 21 is a view of a Recorder in which the style is operated electrically.

Figure 22 is a plan view of a machine or apparatus constructed in accordance with the invention or in which the record is made on a Cylinder. In this view the reproducer is shewn in place and the Recorder omitted. Figure 23 is a vertical cross section of the same apparatus in elevation looking to the right in Figure 22. Figure 24 a section in the plane of Figure 23 but in elevation looking to the left, the Recorder being shewn in place and its mouth piece being broken away. Figure 25 a view similar to Figure 24 but with the reproducer in place instead of the recorder. Figure 26 a partial vertical longitudinal section on line x x of Figure 23—Figure 27 an elevation partly in section of a part of the left end of the machine.

Figure 28 is an elevation partly in section of the Recorder its carrier and sound concentrator—Figure 29 a top view (on a reduced scale) of the sound concentrator of the Recorder—Figure 30 a central section of the Recorder in a plane at right angles to those of Figures 24 and 28 shewing the base or carrier in elevation and figure 31 a section through the base or carrier of the recorder.

Figure 32 is a central vertical section of the reproducer its carrier and certain accessory parts. Figure 33 a face view of the Reproducer. Figure 34 a perspective detail view. Figure 35 a section through the base or carrier of the instrument. Figure 36 a section illustrating a modified form of style. Figure 37, an elevation partly in section (on a reduced scale) of a listening device with double ear pieces and figure 38 a section illustrating another modification of the reproducer.

Referring to figures 1—11. A is the base or bed of the apparatus and B an upright frame which carries the mechanism for supporting and moving the tablet F (shewn as a disc) on which the record is to be, or has been, formed—In the slide C moveable in ways of the frame B. is journalled an arbor D on which are fixed a metal disc E at one end and a bevel gear 1 at the other. The arbor projects beyond the metal disc E so as to form a support for the recording tablet F which is retained thereon by the nut 2 and washer 3. The metal disc E performs the double function of a friction wheel and of a backing to the recording tablet F.

The bevel gear 1 engages a similar gear 4 on the end of the screw 5 which is journalled in a bearing in the slide C and is tapped through a stationary lug 6 on the frame B—As the arbor D is revolved the screw is turned also, and in consequence of its engagement with the lug 6 it moves the slide C lengthwise of the frame B. The rotation is communicated to this arbour from the shaft 7 journalled in bearings of the frame B and provided at one end with a fly wheel 8

and crank handle 9 and at the other end with a friction pinion G. This pinion is formed as shewn of rubber discs clamped together between metal washers—It bears against the back of metal disc E and communicates motion to : —As the slide C is moved by the action of the screw 5 the metal disc E is carried past the friction pinion so that it touches the metal disc in a spiral line and serves to give an uniform surface speed to each part of the disc as it in turn comes opposite said pinion.

The Recorder H is placed on the opposite side of the metal disc E preferably as shewn with the point of the graver or cutting style 11 directly opposite the point where the pinion G touches the disc E The said pinion thus acts as a support to the disc against the action of the cutting or recording style—The latter is preferably formed of a round wire by turning the end conical and rounding the extremity and then grinding off one end to the axis of the wire.

This leaves sharp cutting edges on both sides of the tapering point. These edges remove the material in chips or shavings like a plane or turning tool. It is not essential to give this form to the style—Any form which will remove the material and not simply displace it will answer.

The style is set in one end of a block 12 provided on the opposite end with a cup 13 (see figure 4) and secured in the cross-piece 14 by the nut 15. The cross piece 14 is fastened to a ring 16 into which a back plate 17 is secured. These parts except the steel style are preferably of hard rubber although they could be made of other material, of brass for example.

A sound conveying tube 18 is screwed into the back plate 17 the end being just behind the cup 13. A diaphragm 105 of any suitable material whose edges are clamped between the ring 16 and back plate 17 is placed behind the cup 13 which is pressed against said diaphragm by the elasticity of cross piece 14.

The tube 18 forms part of a hollow standard upon which the recorder is mounted. The lower part 19 of this standard is hinged in the bracket 20 as clearly shewn in figure 2, so that it can be rocked to bring the Recorder into or put it out of action.

On the tube or standard 19 is a ring-weight Z which is retained in position by a set screw 127. It therefore can be adjusted up or down in order to increase or diminish the pressure of the style 11 against the tablet F. The use of this weight is desirable but not necessary.

The tube 21 communicates with the interior of the hollow standard through the hinge and does not therefore interfere with its freedom of motion. This tube 21 can be fixed in the bracket or can be allowed to turn as may be preferred.

The mouth piece I is shaped to fit the face of the user and is provided with a notch 22 to receive the nose. It is attached to the tube 23 which at its lower end fits snugly in the tube 21 and communicates through the series of tubes 23, 21, 19 and 18 with the space inside and back of the cup 13.

In operation the recorder rests by its own weight assisted by the pressure of weight Z, or by its own weight alone if preferred, against the recording tablet F, said weight causing the style to engrave itself to the proper extent in the recording material—The sonorous vibrations impressed upon the style are so rapid as well as so minute that the record is made as perfectly as if the Recorder were held positively, while at the same, time the recorder can be moved bodily to conform to the unevenness of the surface of the tablet and thus keep uniform the depth at which the style operates.

The tablet F consists of a paper or paste board foundation 24 with a coating 25 of wax—A composition excellently adapted to the purpose and according to experience the best, consists of one part by weight of white beeswax and two parts of Paraffine. The two bodies are melted together and if not perfectly free from dirt and grit should be filtered. A filtration through Cotton wool will answer. The coating is or may be about $\frac{1}{20}^{th}$ of an inch in thickness (the paper being $\frac{1}{10}^{th}$ of an inch more or less) and can be made by flowing the melted composition over the paper disc or foundation. The surface is preferably turned off flat on a lathe.

In order to place the tablet in the machine the recorder H is turned back out of the way. When the tablet has been secured in place the recorder is turned forward into the position shown the style resting against and slightly penetrating the wax coating. A penetration of $\frac{1}{100}$ of an inch has been found very effective the style being formed of N°. 16 wire shaped at the cutting end as in figures 5 and 6.

Upon turning the fly wheel 8 the disc E and tablet F will be turned and the style 11 will cut or engrave a spiral line in the wax coating of the tablet—If one talks into the mouth piece I the style will be thrown into vibrations corresponding to the spoken words and the engraved line will be of varying character the inequalities or variations from uniformity representing the forms of the sound waves.

The reproducer K shewn in figures 7 and 8 for reproducing from the engraved tablet or from other suitable record, the sounds which formed said records has a reproducing style 26 formed of a narrow metal strip bent near the end as shewn in Figure 8 and pointed as shewn in Figure 7. This style is held by cementing rivetting or otherwise, between the strip 27 and the circular plate 28 both preferably of hard rubber. The strip 27 is fastened at the bottom to an offset on the block 29 in which a passage is formed for the sound waves. This passage terminates just behind the plate 28. There is a fixed disc 30 of the same size as the moveable plate 28—It is cemented or otherwise fastened on the face of the block and is perforated at the centre in order not to obstruct the opening therein. The plate 28 is close to but not in contact with the disc. The tube 31 fixed at the upper end to the block 29 is joined at the lower end to the tube 33 by a section of soft flexible vulcanised rubber tubing 32. For use the tube 33 is slipped into the tube 19 in the manner shewn for the tube 18 of the Recorder.

The reproducer K when so placed is mounted upon a hollow standard composed of the tubes or tubing 31, 32, 33, and 19, and in consequence of the flexibility of the Rubber tubing 32 it is free to follow the Record. No special care is necessary to insure its adjustment for if the reproducer K be allowed to rest against the record with the style upon the engraved line, the style will of itself gravitate to the bottom of the groove.

There exists always a liability to disarrangement in some part of the machine either in the Recorder or the support therefor or the recording tablet or its support; or if there be no disarrangement it would be difficult to insure that the reproducing style should touch the record precisely at the proper point if the reproducer be held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the Record. It will be seen that the reproducer is mounted on an universal joint so that it can move in any direction. The movement parallel with the face of the tablet would however by itself allow the style to follow and adjust itself to the record to a useful extent.

In operation the reproducer K is placed against the record and on turning the wheel 8 in the same direction and at about the same speed that it was turned in recording, the record will move the style 26 and plate 28 so as to throw the air in the hollow standard into vibrations and produce sound waves similar to those which originally acted upon the recording style to make the record.

The reproduced sounds are audible by placing the ear in proximity to the mouth piece I but it is preferred to withdraw said mouth piece and to connect the flexible tube 34 (see figure 11) with the tube 21 and listen at the ear piece 35.

After the record has been cut it will of course be understood that the machine is turned back to the starting point for reproducing.

The surface of the cut record can be rendered more smooth by removing the engraved tablet from the machine and exposing the surface to heat as for example by rotating the tablet face downward over an Alcohol lamp until the surface begins to glisten. Of course a too long exposure would destroy the Record—It is the merest surface action that is required The record can be used for reproducing without submitting to this operation and without removing it from the machine.

It may however be removed and at any time thereafter replaced on the same or a similar machine and be made to reproduce the original sounds.

The Reproducer K¹ shewn in figures 9 and 10 has the style 26 attached to the outer of two light plates 36 and 37 which are attached to a diaphragm 38 of thin sheet rubber clamped at the edges between the ring 39 and the border of the back plate 40. The tube 31 is fastened in the back plate.

It will be observed that in both forms of reproducer the style 26 projects beyond the edge or end of the instrument so that the position of its point on the record can be easily seen.

Referring now to figures 12—17 A is the bed B and upright frame D an arbour, E a metal disc, F the tablet and G a friction pinion as in Figures 1—11. The nut 2 and washer 3, the shaft 7 wheel 8 and crank 9 and the paper disc 24 and wax coating 25 are identical with the parts similarly numbered in Figures 1, 2 and 3.

The arbor D instead of being journalled in a slide is carried by an arm L which is supported by and is fixed on the short shaft 50. This shaft is supported on centres 51 and 52 so that the arm L can be rocked. The worm wheel 53, loosely mounted on the shaft 50 is held stationary by the clamp M the jaws 54 fitting on either side of the wheel and being pressed against it by the thumb screw 55.

The arbor D carries a screw wheel 56 which engages the worm pinion 57 at the upper end of shaft 58. The screw 59 at the lower end of the shaft engages the worm wheel 53. This shaft 58 and the gears 57 and 59 carried thereby prevent the arm L being turned independently of the worm wheel 53 except as the said shaft is rotated. As the arbor D disc E and tablet F are rotated the screw wheel 56 turns the shaft 58 and consequently the worm wheel 53 being held stationary by the clamp M the arm L is swung gradually to one side so that the recorder engraves a spiral line on the wax face of the tablet.

When the record has been cut it is only necessary in order to restore the tablet to the starting point for reproducing, to throw back the recorder and to loosen clamp M when arm L can be moved at once to the proper position.

A recorder constructed and mounted precisely as in figures 1, 2, 3, and 4 could be used in this machine but as shewn the recording instrument H¹ is modified to some extent. The cutting style 11 (which is the same as that of Figures 4—6) is set into a block 60 carried by a metal strip 61. This is fastened to a block 62 at the lower end of a back piece 63 which is attached to the upper end of the tube 64 which forms the hollow standard for the recorder and which is mounted on the bracket 65 so as to be capable of being turned to put the record into or out of action. The sound conveying tube 66 corresponding to tube 21 of Figures 1 and 2 communicates through the hinge with the interior of the tube 64.

In front of the opening at the upper end of tube 64 is stretched a diaphragm 67 of thin sheet metal or it may be of other material its edges being clamped between the ring 68 and back piece 63, soft rubber rings 69 and 70 being interposed one on each side of the diaphragm—On the opposite side of the diaphragm 67 from the tube 64 a light plate 71 of metal cupped in the centre is held against the diaphragm by the pressure of the strip 61 a projection on the back of said strip bearing against the said plate 71.

In this machine the reproducer K instead of being mounted on the same bracket as the recorder when the latter has been removed, is carried by a separate bracket 72 the tube 33 being hinged thereto so that the recorder and reproducer remain or may remain always attached to the machine, it only being necessary to turn one or the other into position as may be required.

Referring to figures 18—20, A is the base or bed B an upright frame 7 the driving shaft 8 the fly wheel 9 the operating crank handle and G the friction pinion as in figures 1 and 2. The arbor P is supported in an upright position in bearings of the frame A. B. and is revolved by the friction pinion G engaging the friction disc Q.

The record is made on a wax coated strip of paper R which is passed around the periphery of the disc S in the groove formed therein—As the strip passes in front of the recorder or reproducer it is wound off one reel say the reel T and upon the other reel U. The strip can be wound back upon the reel T when desired. Each reel rests by its own weight upon a platform or flange 75 at the upper end of a hollow shaft 76 which turns upon a stand 77 fastened at the base to a bed B. A pin 78 passes through the centre of the reel and forms a journal for it to turn upon. A nut 79 holds the reel on and may be used to bind it with more or less tension. On each shaft 76 is a belt pulley 80 and 81 respectively driven by a crossed belt 82 or 83 from a pulley 84 or 85 on the Arbor P. These pulleys 84 and 85 are loose upon the arbor but are provided each with a clutch 86 and 87 so placed (see figure 18) that when the arbor is turned to the left the clutch 87 engages the hub 89 on the arbor and the pulley 85 is turned therewith while when turned to the right the clutch 86 engages the hub 88.

Each shaft 76 has a stop clutch 90 and 91 respectively, which holds it stationary when the strip is being wound on the other reel. Thus when the arbor P is turned to the left the reel U is revolved in the direction indicated by the arrow and the sleeve supporting reel T is held stationary. The strip is thus stretched at all times, the degree of tension depending upon the friction between the reels and their supporting flanges 75.

The recorder H^{11} is carried by a cross piece 92 supported by posts 93. The style 11 is carried by a cross piece 94 to which it is attached by means of the cup 95 of hard rubber which forms a nut on the screw threaded shank of the style and said cup rests against a mica diaphragm 96 whose edges are clamped between the screw ring 97 and the back plate 98. The tube 18 screwed into the back plate is fastened by soldering or otherwise to the cross piece 92. The tube 23 of the mouth piece I fits into said tube 18. The ends of the cross piece 92 are slotted to fit around the screws at the top of posts 93 and rest upon nuts 99 and are clamped by nuts 100. By means of these nuts the vertical position of the recorder can be adjusted. After one line has been engraved on the strip the recorder can be adjusted to engrave as many additional lines parallel thereto as the strip will receive. The slots in the cross piece 92 allow the recorder to be moved towards and away from the strip so as to regulate the depth of the engraved line. To ensure a greater nicety of adjustment, screws 101 are tapped through the metal at the closed ends of the slots and bear at the point against the supporting screws. The Reproducer K^1 (Figure 20) is similar to that shewn in Figures 9 and 10 except that the style 26 is so placed that the point is at the centre instead of projecting beyond the edge of the instrument. Its position on the Record is therefore not so readily seen but with the form of machine shewn in these figures this is less important. The same may be said of the loose mounting of the reproducer although in point of fact the thin rubber diaphragm 38 gives a certain lateral play to the style. The tube 31 is rigidly fastened to a cross piece 102 identical with the cross piece 92 and with said tube 31 the hearing tube 34 and ear piece 35 are connected.

The paper strip can be easily coated with the beeswax and paraffin compound by running the same through a body of melted composition and scraping one side leaving what adheres to the other to harden thereon.

In figure 21 an arrangement for operating the recorder by electro magnetism is shewn The magnet 107 is mounted on a bar 108 journalled in bearings in standards 109. It is provided with a bobbin 106 of wire surrounding the pole piece which bobbin is included in a circuit over which electrical undulations are caused to pass by any suitable transmitting instrument; for example such as commonly employed on Telephone lines.

In front of the pole piece or core of the bobbin is a diaphragm 105 of magnetic material whose edges are clamped between the ring 16 and back plate 17. The cup 13 should always be in contact with diaphragm 105 and be pressed against it

by the spring of piece 14. This cup as well as the style 11 block 12 nut 15 and cross piece 14 is the same as in the Recorder H of figures 1—4.

Referring to figures 22—28 the frame of the machine as therein shewn consists of two upright side pieces 300 and 301 connected by tie rods 302 and 303 and the tube 304 which serves as a tie rod. The tablet holder 305 in the form of an elongated metal Cylinder is journalled in bearings at the top of the side pieces. The right journal 306 is ball shaped and rests in a socket (see figure 26) which permits the tablet holder to be tilted up, as indicated in dotted lines as well as to be revolved, while endwise motion is effectually prevented. The fly wheel 317 provided with a crank handle is mounted on a prolongation of the journal and serves to revolve the tablet holder. The left journal 307 which is or may be Cylindrical fits and revolves within a box 308, which is held in place on the journal by a screw 309 in the end thereof. The box 308 is confined between a seat on the side piece 301 and the hinged cap 310 which is held down by the spring Catch 311 (see Figure 27) fastened at the bottom in the plug 312 which is adjustably retained in position by the set screw 313. The catch can be released at will by a push pin 314. Below the journal 307 is a follower 315 fitting into and moveable in a hole in side piece 301 acted upon by the spiral compression spring 316 placed below it in the hole. The box 308 rests upon the top of the follower and relieves the journal of all pressure from the spring 316 when the cap 310 is held down by the catch 311. This pressure prevents the box turning. On releasing the catch 311 the spring 316 expands and throws up the journal 307 and the cap 310 as shewn in Figure 27. The cap can then be turned back and the tablet holder be tipped up and held in an inclined position by a hand on the fly wheel 317. The tablet consists of an elongated hollow Cylinder or tube 318 of paper or pasteboard (say one fortieth of an inch in thickness) coated with a layer about one thirtieth of an inch in thickness of a compound of one part by weight of white beeswax and two parts of paraffin. The beeswax and paraffin should be melted and stirred together and then filtered unless they are entirely free from sticks dirt and other foreign particles. The coating is or may be applied by stopping the ends of the cylinder partly immersing it in a bath of the melted composition and turning it therein one or more times, removing it and allowing the material to harden keeping it in motion meanwhile to prevent running then immersing and rotating it again and allowing the adherent layer to harden and so continuing until a coating of rather more than the thickness above indicated is attained. The surface is then turned smooth in a lathe, being supported on a Cylinder like the tablet holder 305. The tablet is then ready for use by placing over the holder or it may be kept until wanted—In keeping care should be taken to prevent access of dust.

After the tablet has been placed on the holder the detachable end of the latter is pressed down into its bearing and the cap 310 is engaged by the catch 311, which holds it down.

The record is made on or in the wax coating of the tablet by the instrument shewn in Figures 24 and 28—31. The diaphragm 320 (of Mica from six to twelve one thousandths of an inch in thickness) is held in a frame 321 between the flange 322 and a ring 323 of soft rubber tubing which is held down by the back plate 324 and screws 325 tapped into the frame. The heads of these screws project over the edge of the back plate. The recording style 326 formed of a steel wire (say $\frac{1}{12}$ of an inch in diameter) sharpened at the front or operating end like an ordinary round pointed turning tool and screw threaded at the other, is fastened to the centre of the diaphragm by the nut 327 and washer 328 which are on opposite sides of the diaphragm and clamp it between them.

The cutting edge of the style is preferably shaped to cut a groove of curved rather than of V shaped cross section—A bar 329 is hinged at one end to the frame 321 by a pivot screw 585 and at the other adjustably but rigidly fastened thereto by a screw 330—A second screw 331 bearing at the point against the top of the bar 329 assists in securing an exact adjustment and in holding the bar

rigid—At the middle of the bar is an enlargement 332 which extends into close proximity to the recording style (see figure 30) and whose bottom is polished or made smooth so that it may bear upon the wax coated tablet and move over it without injury to the wax surface.

The frame 321 is provided with a base or carrier 333 in the form of a half nut In use this nut is supported and engaged by the rotatory feed screw 334 which is journalled in bearings in the side pieces 300 and 301. The base or carrier is elongated to give a sufficient bearing on the screw to prevent the tipping of the recorder sideways. To assist in preventing this and also to prevent the Carrier being lifted from the screw a guard is provided which consists of a block 335 attached to the end of a curved slide 336. This slide is guided by the piece 337 and can be turned from the position shewn in Figure 28, when the guard does not interfere with the placing of the carrier on the screw, into the position shewn in Figures 24 and 31 when it prevents the removal. The Carrier is however free to turn on the screw as on an axle so that the Recorder under the action of gravity will press against the tablet the bar 329 forming a rest to support it. The recording style projects beyond the rest and enters the wax coating penetrating it a distance which is regulated by the adjustment of said rest or bar 329. The sound Conveyor consists of an elliptical mouth piece 338 and a tapering tube 339 both made for lightness of hard rubber in thin sheets say one thirty second of an inch thick— A metal thimble 340 is attached to the small end of the tapering tube which fits over a tubular projection 341 on the back plate. The rotation of the feed screw 334 moves the Recorder lengthwise of the recording tablet and this movement in connection with the rotation of the tablet causes the style to trace a spiral line in the wax which line becomes a sound record by talking into the mouth piece 338 and thereby impressing sonorous vibrations upon the diaphragm and style—The style then cuts a variable line whose irregularities or inequalities correspond to the sound to be recorded. The spiral line can be omitted for a given distance when desired by simply lifting the recorder from the tablet. The feed screw 334 should be so mounted as to prevent endwise movement which would tend to make the tracing line more or less zig zag.

As shewn a spring 342 (see figures 22 and 27) presses constantly upon the left end of the screw to keep it against the bearing at the opposite end. The feed screw is revolved by the friction wheels shewn in figures 22, 23 and 26—In recording the friction pinion 343 on the tablet holder communicates motion to the large wheel 344 fast on the feed screw through the intermediate 345. Thus the feed screw has a much slower rotation than the tablet holder and the convolutions of the line traced on the tablet are much closer together than the threads of the feed screw—The intermediate 345 is mounted on the stud 346 (see figure 26) which is carried by a hinged frame so that the intermediate can be moved out of contact with the pinion whenever it is desired to stop the feed without interrupting the rotation of the tablet holder. The hinged frame consists of side bars 347 which are hinged separately on the tie rod 302 and are rigidly connected with each other by tie bars 348 and 349—A spring 350 under each side bar tends to lift the frame and press the intermediate 345 against the pinion 343. The feed screw is therefore normally in engagement with the tablet holder but can be disengaged at will by pressing upon the tie bar 348. The friction wheels 351. and 352 are for reversing the revolution of the feed screw. The wheel or pinion 352 is simply a hub on the side of the intermediate 345. The wheel 351 presses against the pinion 352 and is mounted on a stud at the end of bent lever 353 which turns upon the screw stud 354 in line with the stud 346 (see Figure 26) The lever 353 thus turns about the axis of the wheel 352 and the wheel 351 may roll over the surface of the wheel 352 so as to be pressed against and thus engage the pinion 343 on the tablet holder.

The short arm of the bent lever is connected by a link 355 with the stud 356 itself secured fast to the side piece 300. When therefore the tie bar 348 and side bars 347 are depressed the lever (as shewn in figure 23) is turned to the left and

when it is sufficiently depressed the wheel 351 is held against and engaged by the pinion 343. Motion is now communicated through the wheels 343, 351, 352, and 344 the rotation of the feed screw is reversed and a more rapid rotation is imparted to it. The carrier will therefore be moved backwards (to the left in Figure 22) more rapidly than it was advanced. There will ordinarily be not much occasion to use the stop and reversing mechanism in recording It is for use in reproducing that it has been specially devised.

The reproducer (see figures 23, 25, 32, 33 and 34) has a style 357 welded or otherwise fastened to the end of a flexible strip 358 of thin steel (say one thousandth of an inch in thickness) so as to project beyond both edges of the same like a hammer head The outer end of this style (which should be somewhat more tapering at the point than the recording style) rubs over the record or tablet; the inner end presses upon a light flat spring 359 fastened at the lower end to the frame 360 of the reproducer. The strip 358 is soldered into a slit of the ear 361 on the spring which by bending between the ear 361 and where it is attached to the frame 360 allows the style and strip to be moved in or out and thus serves to hinge the same to the said frame.

The diaphragm 362 of hard rubber about seven one thousandths of an inch in thickness is pressed against a central seat in the face of the frame 360 by means of the spring 359 between which and said diaphragm is a little block 363 of cork. It serves the double function of pressing the diaphragm against its seat and also of communicating vibrations to it. Cork is used because it is light and conveys vibrations well and has sufficient friction upon the diaphragm and spring to remain in the position in which it may be placed. By leaving it to be held by friction it can be adjusted by the user to give the best effects but it can be secured by cement or otherwise in the position which the maker or adjuster of the instrument may determine preferably it occupies a position intermediate of the style 357 and the edge of the diaphragm as shewn; but it can be set directly opposite the style—In the former position there is a certain length of the spring 359 beyond the cork which length forms a tongue with a very high rate of normal vibration It absorbs a considerable portion of the small vibrations which produce scratching noises and it thus makes the articulation more distinct. It also reduces somewhat the loudness of the sounds reproduced but the increased distinctness more than compensates for any loss in loudness. Another effect which the tongue has is to return the style more perfectly when it has been pushed out by an elevation on the record. It does this because its normal vibration is quicker than that of the diaphragm or because its amplitude of vibration is larger or for both reasons. It will be understood that this spring tongue is compressed by the weight of the reproducer which is sustained by the style. This weight is actually very small the frame being made for lightness of hard rubber but in comparison with the strength of the spring tongue it is considerable.

It will be observed that the diaphragm is strained by the spring in addition to the strain due to the weight of the reproducer.

The inner end of the style 357 preferably rests in a hole or recess in the spring 359 so that it is prevented from side motion bodily although capable of rocking on the inner end as a centre—The bending of the strip 358 allows this side movement of the front end of the style to take place with the greatest freedom. A bodily movement of the style sidewise should be permitted if desired but a stop should then be used to prevent it from being pushed off the spring 359. To protect the style and other parts of the reproducer, a guard 364 is fastened to the front of frame 360 and is perforated at the centre for the passage of the style. On either side of the centre it is bent outward to form horns to support the instrument when placed face downward on a table or flat surface.

The reproducer consisting of the parts just described is mounted upon a hollow standard 365 which is hinged at the bottom to the carrier 366 by means of hollow trunnions 367 fitting in hollow uprights 368 on said carrier. The reproducer standard 365 is provided with a thumb piece 369 which can be pressed to hold up

the reproducer in placing the carrier on and removing it from the feed screw 334. There are front and back screw stops 370 and 371 which limit the movement of the reproducer independently of the carrier. This latter is provided with a half nut to rest upon and engage the feed screw the same as the carrier of the recorder It is not provided with a guard to retain it on the feed screw because it is considered unnecessary particularly when a flexible sound conveyor is employed as will presently be described. It is provided with a tail or prolongation 372 which rests upon the tie bar 348 (see figure 25) so that when this is depressed to stop or to reverse the feed screw the carrier will turn to the left (the centre of gravity being on that side of the feed screw) and automatically lift the reproducing style 357 from contact with the tablet 318 in or on which the record is formed.

When the tie bar 348 is released the springs 350 raise it and turn the reproducer and its carrier to the right so that the style again makes contact with the record. It will be observed that the pressure of the springs 350 does not force the style against the record because the reproducer is hinged to its carrier and only its very light weight comes upon the reproducing style and the record.

On the carrier is a brush 373 which when the reproducer is in motion bears upon the record and clears it of dust or shavings of wax or other lightly adhering matter in advance of the reproducing style.

The hollow standard 365 serves to convey sound from the lenticular chamber behind the diaphragm into the uprights 368 with the interior of which the coupling 374 communicates—To this coupling a flexible sound conveyor 375 is attached at one end the other end being connected with an upright branch of the tube 304. Thus the sound is conveyed from the interior of the uprights 368 through the coupling 374 and sound Conveyor 375 and tube 304 the flexibility of said conveyor 375 permitting the traverse of the reproducer as well as the turning of the carrier 366 on the feed screw 334.

The tube 304 communicates with tubes 376 and 377 one at each end of the machine. A hearing tube is or may be attached to either or both tubes. Preferably the apparatus shewn in figure 37 is employed. It consists of two elastic and flexible hollow branches 378 each provided at the outer end with a cup 379 attached by a ball and socket joint and a flexible sound conveying tube 380 for connecting both branches with the tube 376 or 377. As shewn there is a hollow metal coupling 381 at the free end of the flexible tube 380 of such exterior diameter as to fit snugly in the tube which is to receive it (see figure 25) This coupling is provided with a stop cock 387 which can be turned to cut off more or less sound if the reproduction is too loud. This diminution in loudness makes the scratching less distracting to a person with a sensitive ear.

In use the cups 379 are placed one over each ear of the listener the ball and socket joints permitting the cup to adjust itself to his head and the elasticity of the branches 378 drawing them with sufficient pressure to support the apparatus. The branches may be made of hard vulcanized rubber in order to secure the requisite flexibility and elasticity but it is evident that sound conveying branches having these qualities could be constructed of various materials and in various ways. Instead of applying the tube 380 to the tube 376 or 377 it may be connected directly with the coupling 374 the sound conveyor 375 being omitted. This has the advantage of diminishing the length of tube between the reproducer and the ear of the listener but is open to the objection that the reproducer is liable to be pulled from the machine by incautious movements on the part of the listener.

It may be observed that the reproduced sound may be listened to in various ways and that it is possible to perceive the sound by applying the ear close to the reproducer itself.

In the modified form of reproducer shewn in figure 36 the style 382 is made of a thin plate of sheet steel say three one thousandths of an inch in thickness of the form clearly shewn fastened on edge on the spring 359 being soldered in a slit in the ear 383 and a similar slit in the end of the metal end of the metal button 384

which end projects through the spring 359. This button bears upon the hard rubber diaphragm 362 and serves to communicate vibration from the style to it.

In the form of reproducer shewn in Figure 38 the style 390 is interposed between the diaphragm 362 and the flat spring 391 Near each end the style has a rounded shoulder and the ends themselves are of smaller diameter so that they may pass through holes in the diaphragm and spring, as shewn the latter pressing upon the shoulders. The spring 391 whose flat side is towards the diaphragm is attached to the strip 392 which is soldered or otherwise fastened to the post 393.

The spring 391 retains the outer or operating end of the style in place while allowing it freedom to move endwise for impressing vibrations upon the diaphragm. Preferably it exerts a light pressure inwards tending to strain the diaphragm as well as maintain itself in contact with the shoulder on the style. It supplies the place of spring 359 of figures 32 and 36. The strip 392 whose edge is turned towards the diaphragm allows the operating end of the style to move sideways— It thus supplies the place of strip 358 of figure 32. and that which forms the style 382 of figure 36. The construction of Figure 38 has the advantage over the other forms that there is less material to be moved by the vibrations of the style. The parts 391 and 392 can most conveniently be made from a round wire by filing the same flat at proper points.

The operation of the machine has practically been explained in the foregoing description, in connection with the several parts of the machine but an explanation will now be given of the operation as a whole.

Having prepared a hollow paper Cylinder and coated it with the paraffine and beeswax composition, the coated Cylinder 318 (which forms the recording tablet) is placed upon the tablet holder 305 which for the purpose is detached at one end by releasing the catch 311 and tipped up as indicated in dotted lines in figure 26 The detached end of the tablet holder is then returned to its bearings in side piece 301—Having adjusted the rest 329 of the recorder so that the recording style 326 projects beyond the enlargement 332 the desired distance say five one thousandths of an inch the recorder carrier 333 is placed on the feed screw near the left end of the same, the guard block 335 is turned under the screw and the recorder is made to rest against the recording tablet, the weight being supported by the rest 329 and the style 326 penetrating the wax coating. The fly wheel 317 is then turned revolving the tablet holder and tablet and also but at a less speed the feed screw 334. Since the Recorder is moved lengthwise of the tablet as the latter is revolved under it the recording style traces or more specifically cuts in the wax coating a spiral groove whose convolutions are closer together than the threads of the feed screw. The convolutions may be eight one thousandths of an inch apart.

To make a speech record in or on the tablet the speaker places the lower part of his face in the mouth piece 338 and says in a clear and moderately loud voice the words to be recorded the fly wheel being kept in motion at an uniform speed of say one hundred and sixty revolutions per minute. If it be desired to mark visibly a paragraph on the record it can be done by lifting the recorder for a short time from the Record then releasing it and again speaking into the mouth piece. The sonorous vibrations which the speaker impresses upon the air in the mouth piece 338 and tube 339 are taken up by the diaphragm 320 and style 326 and the latter cuts a groove in the tablet which is correspondingly irregular. After the record has been cut over the whole tablet or as much as may be desired the recorder is removed. The tablet is also removed and brushed to remove the wax shavings and then or at some future time is replaced on the tablet holder of the same, or of a similar machine.

The reproducer carrier 366 is placed on the feed screw 334 the tail 372 resting on the tie bar 348. The thumb piece 369 of the reproducer standard is pressed upon to keep the style 357 or 382 from contact with the record until the carrier has been placed on the screw. It is then released and the reproducer falling forward brings the style into contact with the Record. Preferably the grooves are so close together that the ridge between them tapers to an edge on top so that no

matter where the reproducer may be placed the style will enter a groove and being free to move sidewise will owing to the sloping sides of the groove penetrate to the bottom thereof under the action of gravity.

The fly wheel being turned at about the speed used in recording, the reproducer will follow the spiral groove cut by the recorder and will be acted upon by the inequalities or irregularities of the record and made to reproduce sounds or sonorous vibrations similar to those which acted upon the recorder to produce said inequalities or irregularities in the groove. Each elevation as it passes under the style at first presses the latter outward and when the top of the elevation is reached allows it to be returned inward by the tension of the diaphragm and spring or of the diaphragm alone. By these alternating movements repeated for each ascent and descent in the record and corresponding in extent and rapidity with the length and slope of the ascent and descent the diaphragm is thrown into vibrations corresponding in form to the sonorous vibrations which caused the irregularities or inequalities. In addition to these vibrations foreign vibrations due to various causes are also impressed upon the diaphragm. These should be disregarded as far as possible by the listener confining his attention to the speech vibrations. They will in the reproducer shewn in figures 32 and 33 be measurably taken up by the vibration independently of the diaphragm 362 of the tongue formed by the end of the spring 359 which projects beyond the block 363.

In certain speech sounds it is found that the diaphragm responds too sluggishly and that in consequence of this sluggishness the style, if influenced by the diaphragm alone, will not descend to the bottom of a depression in the groove but will skip across thus cutting off more or less of the vibration. The tongue of the spring 359 responds more readily than the diaphragm and diminishes the danger of false vibrations. This spring tongue also absorbs a portion of the speech vibrations thus diminishing the loudness of the reproduced sound; but any loss in this respect will be more than balanced by the improvement in distinctness. The vibrations of the diaphragm being impressed upon the air in the Chamber behind the same are conveyed through the standard 365 the uprights 368 the coupling 374 the flexible tube 375, the tube 304 the tube 376 or 377 the tube 380 and the branches 378 to the ears of the listener. Should it be desired to interrupt the reproduction for a time the tie bar 348 is pressed lightly thereby withdrawing the intermediate 345 from contact with the pinion 343 and stopping the rotation of the feed screw 334 At the same time the reproducer carrier 366 is allowed by the depression of the tie bar to turn sufficiently to lift the reproducer style 357 clear of the record, the front stop 370 coming in contact with the standard 365 and raising the same.

Should one or more words phrases or sentences not be understood the tie bar 348 is pressed more strongly so as to bring the wheel 351 into engagement with the pinion 343 and thereby reverse the rotation of the feed screw. When the reproducer has been carried back beyond the part of the record from which the reproduction was not understood the tie bar 348 is released the style again comes into contact with the record and the reproduction commences at the point to which the reproducer has been brought back. This repetition of what is not understood can be made as often as desired.

Friction wheels for communicating motion to the feed screw are preferred to cog or other toothed gearing (which could of course be used without departing from the invention) notwithstanding their liability to slip, because they run smoother and are more easily engaged and disengaged. A slip between the wheels causes the reproducer to be fed faster or slower than the spiral on the tablet permits the style to advance. As a general thing there is more slip in recording than in reproducing and consequently the reproducer outruns the style slightly. The style should be given enough side play to compensate for this difference in speed, but if not given the only difficulty is that the style will at length slip across the ridge between the grooves and thus escape the action of a portion of the record so that it may be necessary to bring back the reproducer by reversing the feed. The

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loudness of the reproduction is limited as desired by turning the stop cock 387 to the desired extent.

In the foregoing description of the machine shewn in the drawings, dimensions, proportions materials and other details of construction are mentioned with particularity for the purpose of enabling others more readily to make and use the new improvements and not as limitations of the said improvements since it is obvious that modifications can be made in details without departing from the spirit of the Invention and that parts of the Invention can be used separately.

The terms "recorder" and reproducer" as used herein, include simply, means (a style for example) for acting upon a tablet to form a record or being acted upon by a sound record in connection with means whereby vibrations can be impressed upon the recording style or its substitute or can be received from the reproducing style or its substitute and such frame or support as may be necessary to an operative device.

As hereafter employed they mean a recorder or reproducer of any ordinary or suitable description unless a special form is mentioned or is necessarily implied from the connection in which the Recorder or Reproducer is used. For example some forms of recorder and reproducer would not be suitable for use with a wax coated tablet.

In like manner other terms such as tablet, tablet holder, carrier, sound conveyor, gearing, &c refer to devices of any ordinary or suitable description except as otherwise indicated.

A means has been shewn for impressing vibrations upon the recording style by an electrical current through the intermediary of an electro magnet in a manner similar to that in which the diaphragm of an ordinary receiving telephone has been vibrated It is evident that other means heretofore used for vibrating a diaphragm could be used in place of the magnet also it is evident that the vibrations of the reproducing style could be taken up and transmitted by the means heretofore used for taking up and transmitting vibrations (those of a Telephone diaphragm for example).

Having now particularly described and ascertained the nature of the said Invention and in what manner the same is to be performed I declare that what I claim is:—

First. The method of forming a record of sounds by impressing sonorous vibrations upon a style, and thereby cutting in a solid body the record corresponding in form to the sound waves in contradistinction to the formation of sound waves by indenting a foil with a vibratory style, or cutting a strip by vibrating it against a revolving disc cutter; substantially as described.

~~Second. The method of forming a sound record by impressing sonorous vibrations upon a style in a direction at right angles to the recording surface and thereby cutting in a solid body a series of elevations and depressions of varying depth corresponding in form to the sound waves substantially as described.~~

~~Third. The vibratory cutting style of a sound recorder substantially as described.~~

~~Fourth. The cutting style in combination with a support permitting the same to be vibrated and means for impressing sonorous vibrations thereon substantially as described.~~

~~Fifth. A vibratory cutting style in combination with a sound conveying tube for concentrating the sound waves upon the style substantially as described.~~

~~Sixth.~~ *Second.* A vibratory cutting style in combination with a tablet or other solid body in which the record is to be cut, and mechanism for supporting the same and moving it with reference to the said style substantially as described.

~~Seventh.~~ *Third.* A sound record consisting of a tablet or other solid body having its surface cut or engraved with narrow lines of irregular or varied form corresponding to sound waves substantially as described.

~~Eighth. A sound record consisting of a tablet or solid body having its surface cut~~

~~or engraved with a number of lines of variable cross section, the irregularities or variations corresponding in form to sound waves substantially as described.~~

~~Ninth.~~—*Fourth.* The method of forming a sound or speech record, by engraving or cutting the same in wax ~~or a~~ wax like composition, substantially as described.

~~Tenth. The sound or speech record cut or engraved in wax or a wax like composition substantially as described.~~

~~Eleventh. The recording tablet of a Phonograph or sound recording machine having as the material for recording sounds or sonorous vibrations the composition of bees wax and paraffine substantially as described.~~

~~Twelfth. The sound or speech record cut or engraved in a wax like composition such as the compound of beeswax and paraffine substantially as described.~~

~~Thirteenth. A tablet or body for recording sound vibrations consisting of a paper or paste board foundation and a surface coating of beeswax and paraffine compound, substantially as described.~~

~~Fourteenth. The sound or speech record cut or engraved in a wax like composition, such as the described compound of bees wax and paraffine constituting a surface coating to a paper or pasteboard foundation, substantially as described.~~

~~Fifteenth.~~—*Fifth.* The method of making a sound or speech record by engraving or cutting in the recording material an irregular groove with sloping walls the shape of the groove representing the sound vibrations substantially as described.

~~Sixteenth. The method of making a sound or speech record by cutting in the recording material a groove with sloping walls and of variable cross section the variation corresponding in form to sound waves substantially as described.~~

~~Seventeenth. The sound record in the form of an irregular groove with sloping walls cut in solid material substantially as described.~~

~~Eighteenth. The sound record cut in wax or wax like composition in the form of an irregular groove with sloping walls substantially as described.~~

~~Nineteenth. The combination with the reproducing style of a mounting therefor which leaves said style free to move laterally and thereby adjust itself automatically to a sound record substantially as described.~~

~~Twentieth. The reproducer loosely mounted on a suitable support so that the reproducing style is capable of a lateral movement and may in consequence thereof adjust itself automatically on the record substantially as described.~~

~~Twenty first. The reproducer mounted on an universal joint and held against the record by yielding pressure substantially as described.~~

~~Twenty second. The combination with a grooved tablet or other body having a sound record formed therein of a reproducer having a rubbing style loosely mounted so that it is free to move laterally and thus adjust itself to the groove substantially as described.~~

~~Twenty third The combination with the tablet or other body having the sound record formed therein as an irregular groove with sloping walls of a reproducer having a style for rubbing over said record and mounted on an universal joint substantially as described.~~

~~Twenty fourth. The combination with a sound record formed in wax or a wax like material of a reproducer having a rubbing style for receiving sonorous vibrations from said record substantially as described.~~

~~Twenty fifth. A reproducer having a style projecting beyond the edge or end of the instrument so that the position of the point of the style on the record may be readily seen substantially as described.~~

~~Twenty sixth. In a reproducer the combination with a vibratory plate or diaphragm of a reproducing style fastened flatwise on said plate or diaphragm and bent at the end substantially as described.~~

~~Twenty seventh. The method of recording and reproducing sounds by cutting the record in a wax or wax like material and then rubbing over the record the style of a suitable reproducing instrument so as to impress sonorous vibrations on said style substantially as described.~~

~~Twenty-eighth. The method of improving a sound record by producing an incipient fusion of the surface substantially as described.~~

~~Twenty-ninth. The improvement in preparing a sound record by cutting the record in a fusible material and then producing an incipient fusion of the surface substantially as described.~~

~~Thirtieth.~~ *Sixth.* The sound recorder having a vibratory cutting style held against the recording material by yielding pressure substantially as described.

~~Thirty-first. The recording instrument having a vibratory cutting style and mounted on a hinged arm substantially as described.~~

~~Thirty second.~~ *Seventh.* The combination with the tablet or body in which the sound record is to be made, of the recording instrument mounted on a hinged arm and resting by gravity against the tablet substantially as described.

~~Thirty-third. The recorder mounted on a hollow arm or standard which constitutes also a sound conveyor substantially as described.~~

~~Thirty fourth. The recorder mounted upon an arm or standard hinged to its bracket or base and provided with a sound conveyor extending lengthwise of said arm substantially as described.~~

~~Thirty fifth. The recorder mounted upon an hinged arm and combined with a sound Conveyor which extends lengthwise of the arm and is connected at the hinge with an exterior sound conveyor substantially as described.~~

~~Thirty sixth. The reproducer mounted upon a hollow standard which forms a sound Conveyor substantially as described.~~

~~Thirty seventh. The reproducer mounted upon a hinged arm and provided with a sound Conveyor extending lengthwise of said arm substantially as described.~~

~~Thirty eighth. The reproducer mounted on a hinged arm and provided with a sound conveyor extending lengthwise of said arm and connected at the hinge with an exterior sound conveyor substantially as described.~~

~~Thirty ninth. The combination with a sound recorder of a mouth piece shaped to surround the mouth and nose of the user and to concentrate the sound upon the recording device substantially as described.~~

~~Fortieth.~~ *Eighth.* The combination with the tablet in the form of a disc and a recorder or reproducer of mechanism for causing a spiral line to be traced on the disc by the recorder or reproducer at an uniform surface speed substantially as described.

~~Forty first. The combination with the tablet in the form of a disc, the arbor and the metal disc operating as a friction wheel, of a slide or its equivalent such as herein shewn in which said arbor is journalled and the friction pinion or revolving said disc substantially as described.~~

~~Forty second. The combination with the recorder or reproducer, the disc, the arbor and the laterally moveable support to the arbor, of the friction pinion placed behind and bearing against the disc at a point opposite the recorder or reproducer substantially as described.~~

~~Forty third. The combination with a recording style and the support therefor of a cup on the back of said support and the sound conveying tube terminating just behind the cup substantially as described.~~

~~Forty fourth. In combination with the style of a sound producer, a vibratory body or plate of hard rubber upon which vibrations are impressed by said style and through which they are transmitted substantially as described.~~

~~Forty fifth. A tablet provided with a wax like coating and having engraved in said coating a spiral line with inequalities or irregularities corresponding in form to sound waves substantially as described.~~

~~Forty sixth. A tablet provided with a coating of wax or wax like substance and having a sound record engraved in said coating said engraved coating having the glazed surface which results from an incipient fusion after cutting or engraving the record substantially as described.~~

~~Forty seventh. In combination with a sound recorder a flaring mouth piece shaped to fit over the face of the user and to include his nose and communicating~~

through a tube or contracted opening with the space behind the diaphragm of said recorder substantially as described.

Forty eighth. A recording tablet for a Phonograph consisting of a hollow Cylinder provided with a wax or wax like coating for receiving the sound record substantially as described.

Forty ninth. A recording tablet consisting of a hollow cylinder of paper provided with a wax or wax like coating substantially as described.

Fiftieth. The recording tablet consisting of a hollow paper cylinder coated with a composition of beeswax and paraffine substantially as described.

Fifty first. A tubular self sustaining tablet for recording sounds or sonorous vibrations substantially as described.

Fifty second. In a Phonograph and in combination with a sound recorder or reproducer and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet an elongated cylindrical tablet holder supported and journalled so that the tubular tablet can be placed on the same substantially as described.

Fifty third. The combination with a tubular tablet of the tablet holder for supporting and rotating the same substantially as described.

Fifty fourth. A tablet holder journaled in bearings at both ends and detachable from its support at least at one end so that a tubular tablet can be slipped over the same in combination with a sound recorder or reproducer and operating mechanism for causing said recorder or reproducer to trace a spiral line on the tablet substantially as described.

Fifty fifth. A tablet holder detachably connected with its support at one end and provided at the other end with a ball and socket bearing or bearing which permits the said holder to be tilted for placing a tubular tablet on the same in combination with a sound recorder or reproducer and operating mechanism for causing said recorder or reproducer to trace a spiral line on the tablet substantially as described.

Fifty sixth. The combination with the tablet holder the side piece or support at one end of the same and the cap therefor of the catch or fastening for said cap and the spring for moving the tablet holder when the catch is released substantially as described.

Fifty seventh. The combination with the tablet holder and the ball and socket bearing or bearing for permitting the holder to be tilted, of the support and cap at the opposite end of said holder the catch or fastening for said cap and the spring for lifting the journal from said support when the catch or fastening is released substantially as described.

Fifty eighth. The combination with the tablet holder of the box or sleeve on one journal of the same, the support and cap forming the bearing for said box or sleeve, and the catch or fastening for the cap substantially as described.

Fifty ninth. The combination with the tablet holder of the box or sleeve held on one journal of the same, the support and cap forming a bearing for said box or sleeve, and the spring whose pressure acts against said box or sleeve substantially as described

Sixtieth. The combination with the tablet holder of the ball journal and socket bearing at one end of said holder, the box or sleeve on the journal at the opposite end of said holder and the bearing for the same substantially as described.

Sixty first. The combination with the tablet holder, the recorder and the feed screw, of gearing between said holder and feed screw for revolving the latter at a slower speed than the former substantially as described.

Sixty second. The combination with the feed screw, of the carrier or the recorder or reproducer provided with a divided or partial nut for engaging said screw substantially as described.

Sixty third. The combination with the feed screw and the carrier for engaging the same of the movable guard for retaining the carrier in engagement with th screw substantially as described.

Sixty-fourth. The combination with a feed-screw of the carrier for the recorder or reproducer engaged and also supported by said screw substantially as described.

Sixty-fifth. The combination with a feed-screw of the carrier for the recorder or reproducer movable lengthwise of and engaged by said screw and capable of turning on the same as on a journal substantially as described.

Sixty-sixth. The combination with a tablet and tablet-holder of the feed-screw a carrier mounted on said screw and the recorder supported on said carrier and resting against the tablet substantially as described.

Sixty-seventh. The combination with the tablet-holder, feed-screw and gearing between the same of the hinged frame upheld by spring pressure and the devices connected therewith for putting the feed-screw out of action substantially as described.

Sixty-eighth. The combination with the tablet-holder, feed-screw and gearing between the two, of the hinged frame upheld by spring pressure and reversing mechanism connected with said frame for reversing the rotation of the feed-screw relatively to the tablet-holder substantially as described.

Sixty-ninth. The combination with a tablet-holder, a feed-screw, gearing, and an instrument, (the reproducer for example) engaged by said screw of stop-mechanism for putting the feed-screw out of action, and at the same time lifting the instrument clear of the tablet substantially as described.

Seventieth. The combination with a tablet-holder, a feed-screw gearing and an instrument, (the reproducer for example,) engaged by said screw of reversing mechanism for reversing the rotation of the feed-screw, the said mechanism being connected with said instrument so that the latter will be lifted clear of the tablet on the reversal of the feed-screw substantially as described.

Seventy-first. The combination with the tablet and the recorder held against the same by yielding pressure of a rest bearing on said tablet for supporting the recorder substantially as described.

Seventy-second. The combination with the recorder frame and style, and the means whereby sonorous vibrations are impressed upon the style of the rest attached to said frame and arranged close to said style the latter projecting beyond the rest to act upon the recording tablet substantially as described.

Seventy-third. The combination with the recorder of the adjustable rest attached to said recorder for bearing upon the recording tablet substantially as described.

Seventy-fourth. The combination with the recording style, the recorder frame and the means whereby vibrations are impressed upon the style of the rest attached to said frame and adjustable lengthwise of said style substantially as described.

Seventy-fifth. The combination with the recorder frame and the rest attached thereto, of the diaphragm and the recording style, mounted directly on said diaphragm substantially as described.

Seventy-sixth. The combination with the diaphragm, of the cutting style formed of a wire sharpened at its outer end and attached to said diaphragm so as to vibrate with the same substantially as described.

Seventy-seventh. The combination with the diaphragm of the cutting style provided with a screw-threaded shank, and the nut and washer for securing the same to the diaphragm substantially as described.

Seventy-eighth. The combination with a recorder having a cutting style, of the rest for bearing upon the recording tablet substantially as described.

Seventy-ninth. The combination with the tablet having a wax or wax-like coating to receive the record of the recorder pressed towards the tablet by yielding pressure and provided with a cutting style, and the rest for bearing upon the tablet and supporting said pressure substantially as described.

Eightieth. The combination with the recorder of the sound concentrator comprising a flaring mouthpiece and a tapering tube forming a continuation of the same substantially as described.

~~Eighty-first. The combination with the recorder of the sound-concentrator comprising a mouthpiece of elliptical form and a tapering tube forming a continuation of the same substantially as described.~~

~~Eighty-second. The combination with the reproducer of the brush for cleaning the record in advance of the reproducer substantially as described.~~

~~Eighty-third. The combination with the recording tablet having a wax or wax-like coating in which the record is cut, of the reproducer and the brush for cleaning the record in advance of the reproducer substantially as described.~~

~~Eighty-fourth. A recording tablet consisting of a hollow cylinder provided with a wax or waxlike coating and having a sound record cut in said coating substantially as described.~~

~~Eighty-fifth. The combination with the tablet and tablet holder of the feed screw, the gearing, the reproducer carrier, and the brush substantially as described.~~

~~Eighty-sixth. A reproducer having a flexible or flexibly mounted style, movable sidewise independently of the diaphragm or device to which the style communicates vibration substantially as described.~~

~~Eighty-seventh.~~ *Ninth.* A reproducer having the style attached to or in one piece with a comparatively broad and thin strip, placed on edge, said style in consequence of the flexibility of said strip being movable sidewise independently of the diaphragm or device to which the style communicates vibration, but in consequence of the breadth of said strip being practically rigid to pressure in other directions, substantially as described.

~~Eighty-eighth. The combination with the reproducer style and diaphragm or device to which said style is to communicate vibrations, of a comparatively broad and thin strip placed on edge and attached to or in one piece with said style said strip being hinged to the frame so that the style may be vibrated in the plane of said strip substantially as described.~~

~~Eighty-ninth. In a reproducer the style attached to a thin metal strip breadthwise of the same, like a hammer head substantially as described.~~

~~Ninetieth. The reproducer style attached to, or in one piece with a broad and thin strip in combination with a diaphragm or device upon which the reproduced sonorous vibrations are to be impressed, and a spring carrying said style and strip and serving as a hinge to permit them to vibrate substantially as described.~~

~~Ninety-first. The combination with the reproducer style and the diaphragm or device upon which the reproduced sonorous vibrations are to be impressed by said style of a flat metal spring interposed between the style and diaphragm and forming a yielding connection through which the reproduced vibrations are transmitted substantially as described.~~

~~Ninety-second. The combination with the reproducer style and the diaphragm or device upon which the reproduced vibrations are to be impressed by said style, of a metal spring or spring tongue whose normal vibration is quicker than that of said diaphragm and whose tension tends to move the style away from the diaphragm substantially as described.~~

~~Ninety-third. In combination with a diaphragm a frame having a concave seat for said diaphragm the walls of said seat converging to an opening in the back through which the sound may escape substantially as described.~~

~~Ninety-fourth. The combination with the diaphragm and the frame having a concave seat for said diaphragm of a spring for holding the diaphragm to its seat and for straining the same substantially as described.~~

~~Ninety-fifth. The combination with the diaphragm, its supporting frame, and the style of the spring for straining said diaphragm substantially as described.~~

~~Ninety-sixth. The combination with the diaphragm and its supporting frame, of the spring pressing inward on said diaphragm and the style carried by said spring substantially as described.~~

~~Ninety-seventh. The combination with the diaphragm and its frame, of the spring projecting over said diaphragm, the block between the spring and diaphragm and the style bearing upon the spring beyond said block substantially as described.~~

~~Ninety-eighth. The combination with the reproducer-style of the hard rubber diaphragm and the frame for supporting said diaphragm at the edges substantially as described.~~

~~Ninety-ninth. The combination with a diaphragm and its frame, of a spring projecting over said diaphragm, a style carried by said spring, and a block between the diaphragm and spring, adjustable lengthwise of the latter substantially as described.~~

~~One hundredth. The combination with the reproducer of the guard fastened over the face of the same, substantially as described.~~

~~One hundred and first. The reproducer provided with a guard fastened over the face of the same, and curved to form horns upon which the reproducer may rest, substantially as described.~~

~~One hundred and second. The double ear-piece comprising the elastic and flexible hollow branches provided each with a cup connected with the branch by a ball and socket joint substantially as described.~~

~~One hundred and third. The combination with the reproducer and the carrier therefor, and the feed screw for moving them, of a sound conveying tube on the machine frame, and a flexible sound conveyor between the reproducer and the said tube, substantially as described.~~

~~One hundred and fourth. The combination with the reproducer, of the double ear piece comprising the elastic and flexible hollow branches and the cups jointed to the ends of said branches, substantially as described.~~

~~One hundred and fifth. The combination with the feed screw and the reproducer carrier supported and capable of turning on said screw, of the reproducer hinged to said carrier, and a stop for lifting the reproducer when the carrier is turned in the proper direction, substantially as described.~~

~~One hundred and sixth. The combination with the feed screw and the reproducer carrier engaging and capable of turning on said screw, and provided with an extension or tail, of a movable bar under said tail for upholding the same, so that by depressing said bar the carrier can be turned and lift the reproducer from the tablet substantially as described.~~

~~One hundred and seventh. The combination of the feed screw the reproducer carrier mounted thereon and provided with an extension or tail and the bar under said tail for upholding the same, substantially as described.~~

~~One hundred and eighth. The combination with the reproducer carrier, of the reproducer mounted on a standard hinged to said carrier, said standard being provided with a thumb piece or device whereby the reproducer can be held up in placing the reproducer on and removing it from the machine substantially as described.~~

~~One hundred and ninth.~~ *Tenth.* The combination with the tablet, tablet holder, feed screw, gearing, reproducer and reproducer carrier, of the mechanism for controlling the rotation of said feed screw, the same being connected with said carrier so as to lift the reproducer from the tablet, when operated to stop or to reverse the rotation of said screw substantially as described.

~~One hundred and tenth. The combination with the tablet holder and the feed screw of the gearing for rotating the feed screw in the forward direction, the hinged frame for disengaging said gearing when moved a certain distance, and additional wheels connected with said frame so as by a further movement to engage said wheels and reverse the rotation of said screw substantially as described.~~

~~One hundred and eleventh. The combination with the tablet holder the feed screw, the gearing for rotating the same in a forward direction, the gearing for rotating the same backwards at a greater speed, and mechanism for bringing the latter into action, substantially as described.~~

~~One hundred and twelfth. The combination with the reproducer and a conveying tube for the reproduced sounds, of a stop cock in said tube for moderating at will the loudness of the sound to be conveyed to the ear, substantially as described.~~

One hundred and thirteenth. The improved recording and reproducing machine comprising the following elements, in combination: a hollow cylindrical self-sustaining tablet, a tablet-holder journaled and hinged at one end to the machine frame, and journaled and detachably connected with said frame at the other, a feed-screw, gearing for rotating the said screw in either direction according to the wheels engaged, a hinged frame for controlling the rotation of said screw, and the recording and reproducing instruments with their carriers substantially as described.

Dated this 4th day of May 1886.

J. HENRY JOHNSON,
Agent.

Redhill: Printed for His Majesty's Stationery Office, by Malcomson & Co., Ltd.
[G. 6048—125—8/1901.]

Fig 1.

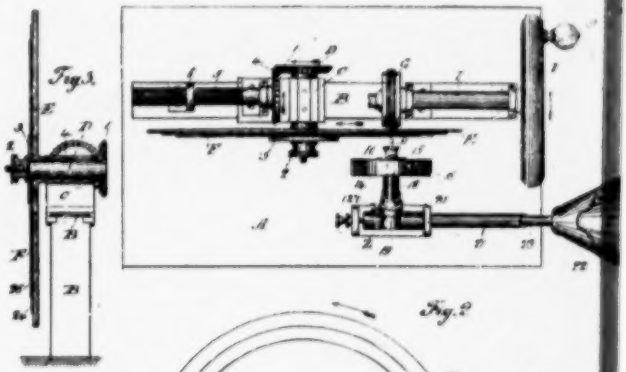

Fig 3.

Fig 2.

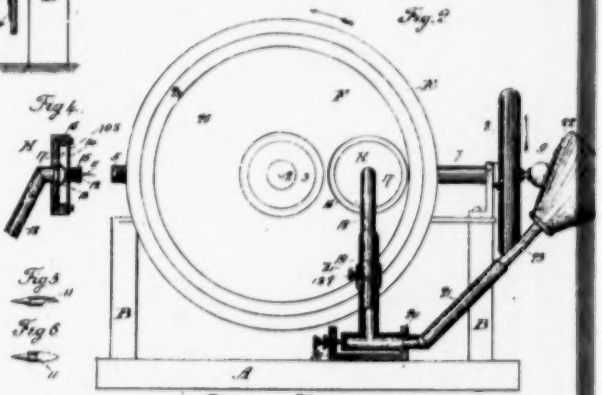

Fig 4.

Fig 5.

Fig 6.

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Fig 7.

Fig 11.

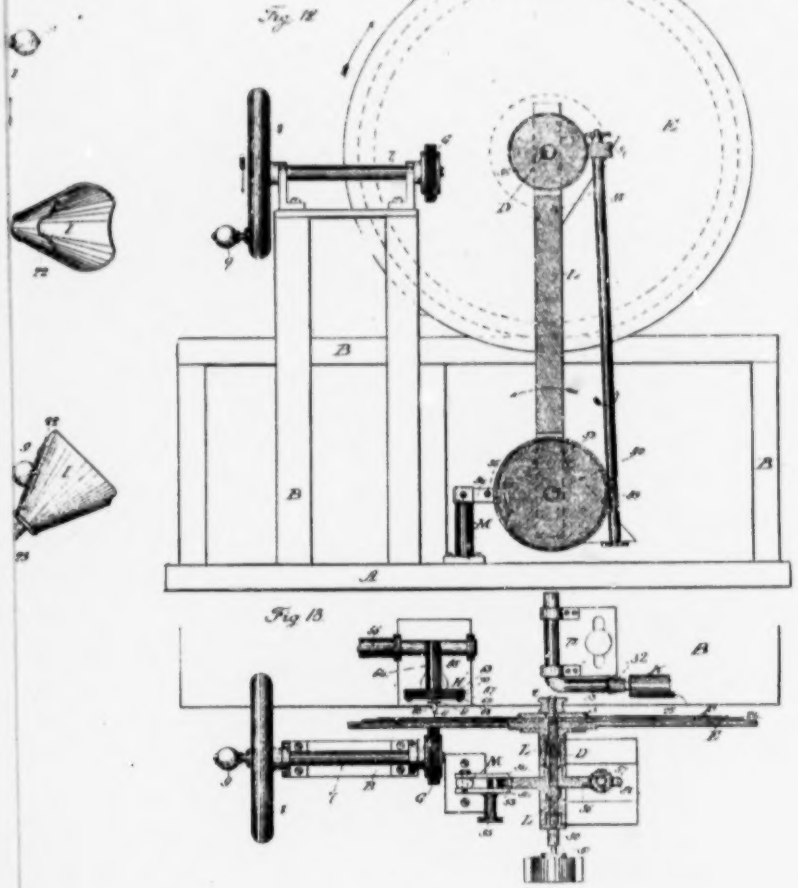

Fig 12

Fig 13

The Drawing is a full size reproduction of the Original

Fig. 11.

Fig. 12.

A.D. 1866. May 4. N° 6017.
JOHNSON'S Amended Specification.
5th Edition.

Fig. 14.

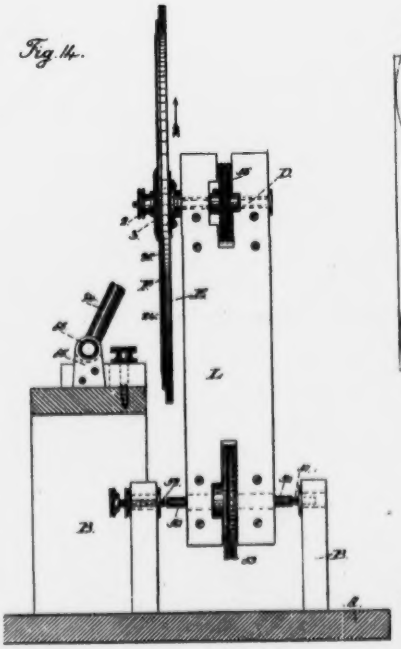

Fig. 18

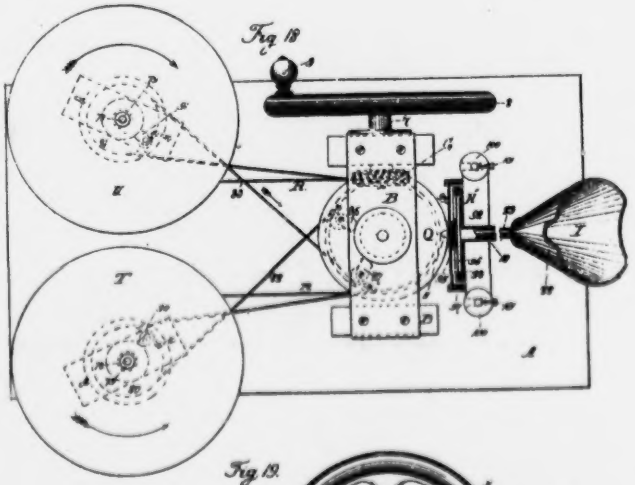

Fig. 19.

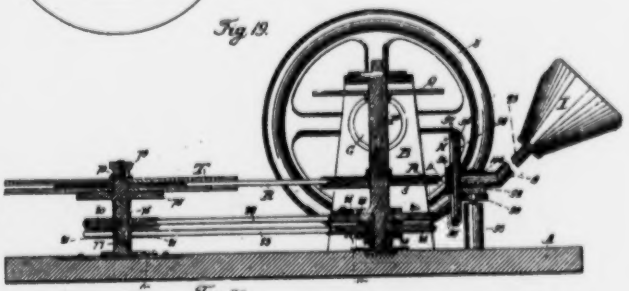

Fig. 15

Fig. 16

Fig. 17.

Fig. 20.

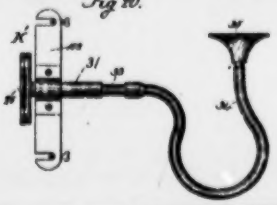

Fig. 22.

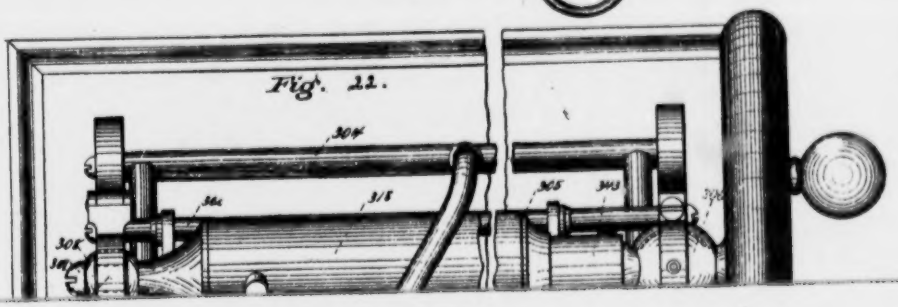

Fig. 21.

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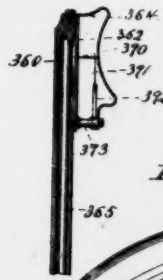
Fig. 28.



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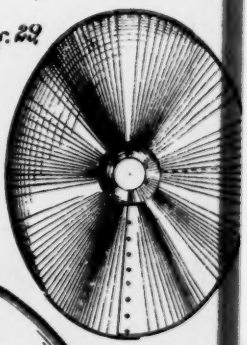
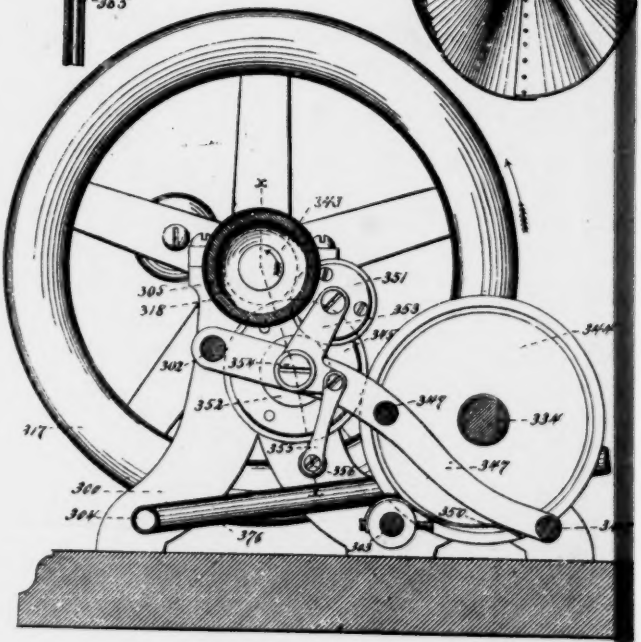


Fig. 23.



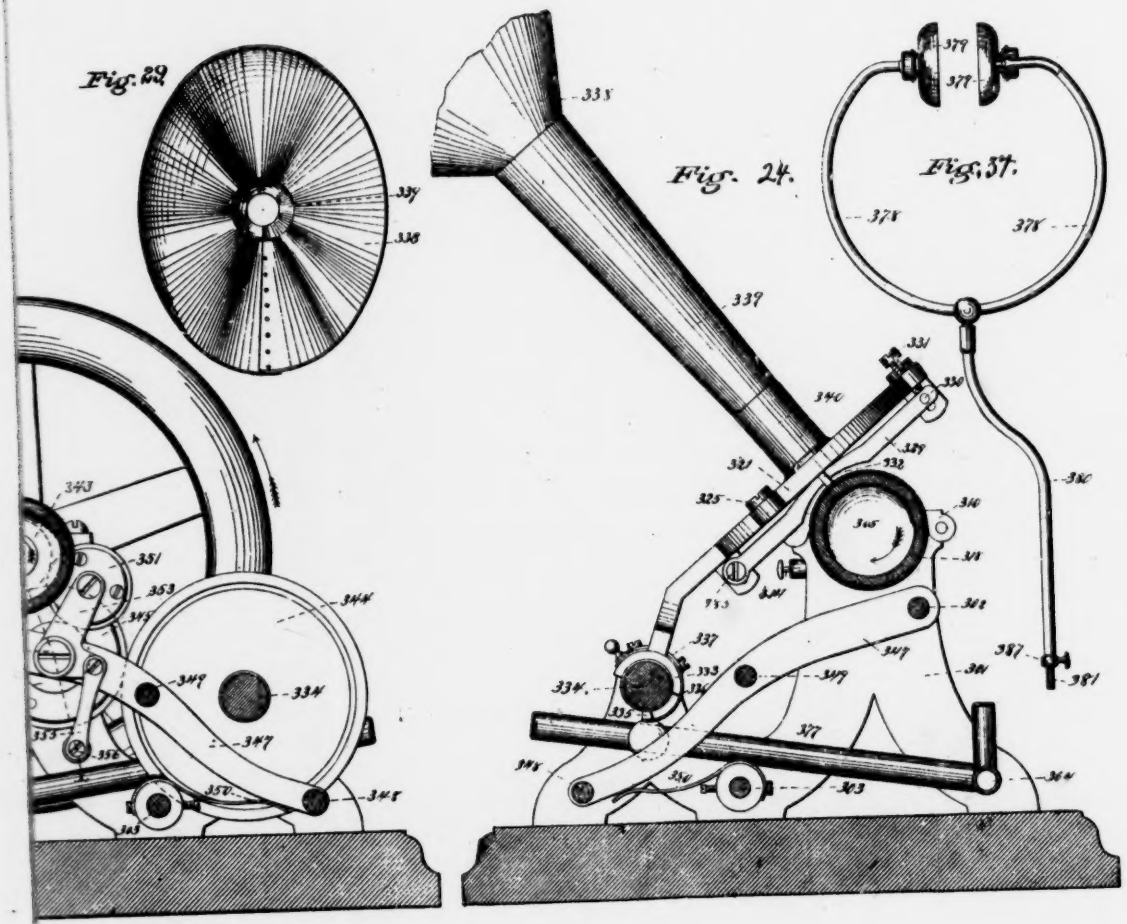


Fig. 23
Fig. 24.
Fig. 37.
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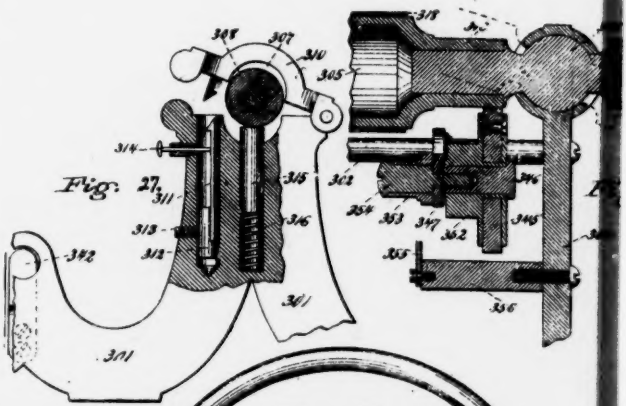
Fig. 27.
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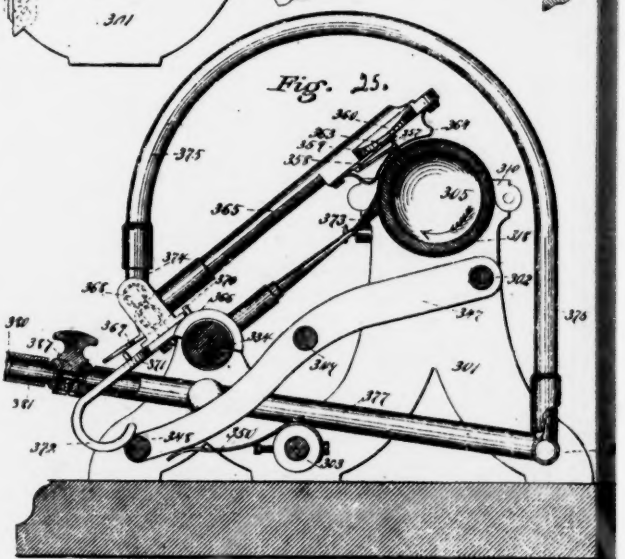
Fig. 25.
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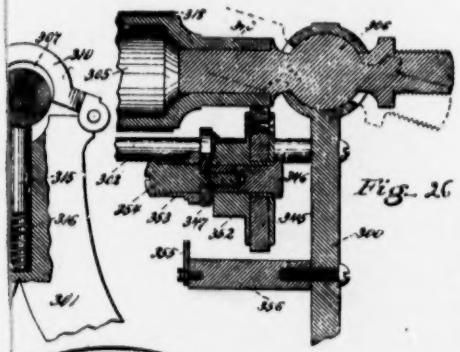


Fig. 26.

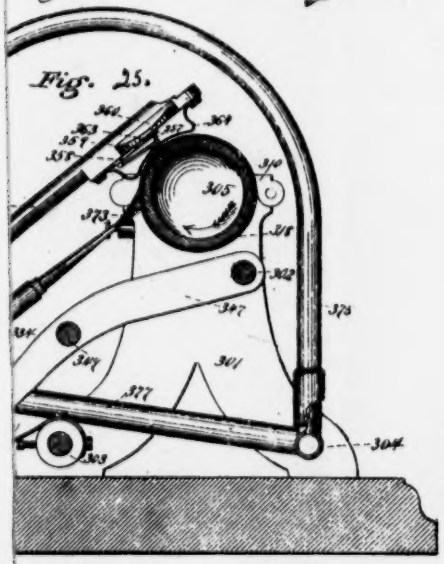


Fig. 25.

Fig. 28.

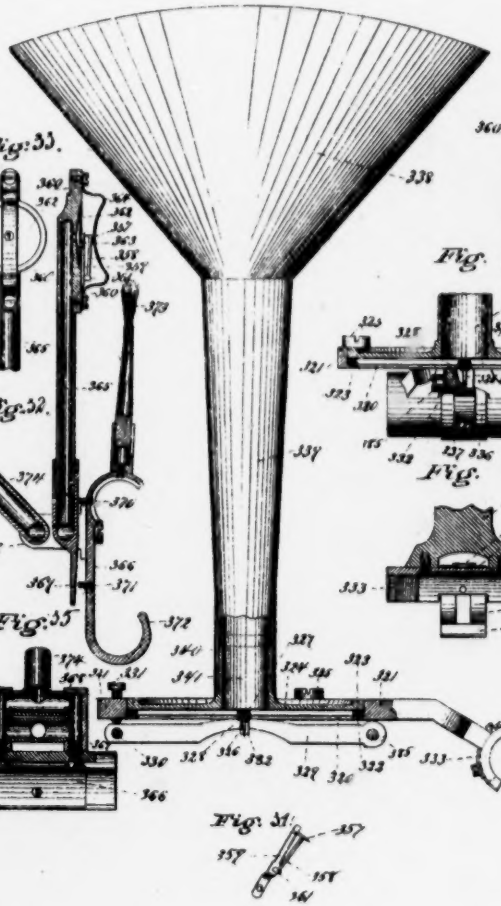


Fig. 33.

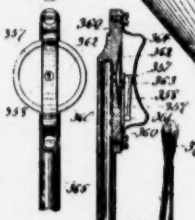


Fig. 32.

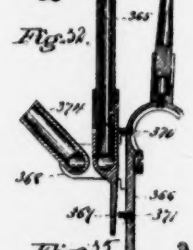


Fig. 35.

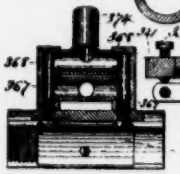


Fig. 36.

Fig. 30.

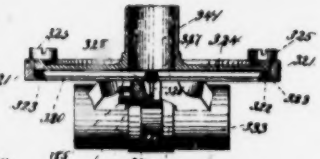


Fig. 31.

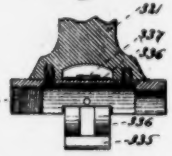


Fig. 31.

[This Drawing is a full true representation of the Original.]

N° 15,232 A.D. 1887

Date of Application, 8th Nov., 1887—Accepted, 9th Dec., 1887

COMPLETE SPECIFICATION.

Improved Method of and Apparatus for Recording and Reproducing Spoken Words and other Sounds.

EMILE BERLINER of Columbia Road Washington in the District of Columbia United States of America Electrician do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

This invention has reference to a novel method of, and apparatus for recording and reproducing all kinds of sounds, including spoken words, and is designed to overcome the defects inherent in that art, as now practised and in the apparatus used therefor.

By the ordinary method of recording spoken words or other sounds for reproduction, it is attempted to cause a stylus attached to a vibratory diaphragm to indent a travelling sheet of tin foil or other like substance to a depth varying in accordance with the amplitudes of the sound waves to be recorded. This attempt is necessarily more or less ineffective for the reason that the force of a diaphragm vibrating under the impact of sound waves is very weak, and that in the act of overcoming the resistance of the tin foil or other material, the vibrations of the diaphragm are not only weakened, but are also modified. Thus, the record, while it contains as many undulations as the sounds which produced it, and in the same order of succession, the character of the recorded undulations is more or less different from those of the sounds uttered against the diaphragm. There is then, a true record of the pitch, but a distorted record of the quality of the sounds obtained.

The simple statement that the material upon which the record is made resists the movement of the diaphragm is not sufficient to explain the distortion of the character of the undulations; for, if that resistance were uniform, or even proportional

to the displacement of the stylus, the record would be simply weakened, but not distorted.

But it is a fact, that the resistance of any material to indentation, increases faster than the depth of indentation; so that a vibration of greater amplitude of the stylus meets with a disproportionately greater resistance, than a vibration of smaller amplitude. For this reason, loud sounds are even less accurately recorded than faint sounds, and the individual voice of a loud speaker recorded and then reproduced by the phonograph cannot be recognised.

With a view of overcoming this defect, it has been attempted to engrave instead of indent a record of the vibrations of the diaphragm, by employing a stylus shaped and operating like a chisel upon a suitably prepared surface; but even in this case, the disturbing causes above referred to are still present. In addition to this, if in the apparatus of the phonograph or graphophone type, it is attempted to avoid the disturbing influence of the increase of resistance of the record surface, with the depth of indentation or cut, as much as possible, by primarily adjusting the stylus so as to touch the record surface only lightly, then another disturbing influence is brought into existance by the fact that with such adjustment when the diaphragm moves outwardly, the stylus will leave the record surface entirely, so that part of each vibration will not be recorded at all. This is more particularly the case when loud sounds are recorded, and it manifests itself in the reproduction, which then yields quite unintelligible sounds.

It is the object of my invention to overcomethese and other difficultiesby recording spoken words or other sounds without perceptible friction between the recording surface and the recording stylus,and bymaintaining the unavoidable frictionuniform for all vibrations of the diaphragm. The record thus obtained, almost frictionless, I copy in a solid resisting material, by any of the methods hereinafter described: and I employ such copy of the original record for the reproduction of the recorded sounds.

Instead of moving the recording stylus at right angles to, and against the record surface, I cause the same to move under the influence of sound waves, parallel with and barely in contact with such surface; which latter is covered with a layer of any material that offers a minimum resistance to the action of a stylus operating to displace the same; all substantially in the manner of the well known Phonautograph by Leon Scott.

All this will more fully appear from the following detailed description, in which reference is made to the accompanying drawings which illustrates two ofthenumerous forms which my improved apparatus may assume, and in which—

Fig. 1 is a perspective view of one form of my recording and reproducing apparatus.

Fig. 2, is a like view of the recording and reproducing diaphragm with its stylus.

Fig. 3, a similar view of a portion of the support for the record surface.

Fig. 4, the same view with the record surface applied.

Fig. 5, a plan view of a phonautographic record.

Fig. 6, a perspective of a phonautographic record, copied in solid resisting material.

Fig. 7, the copied record mounted, ready for application to the support.

Fig. 8, is a perspective view of another form of my gramophone, in which the sounds are recorded upon a plain surface, as distinguished from a cylindrical surface used in connection with the apparatus shown in Figs. 1 to 7.

Fig. 9, is a plan view of the diaphragm with its support, and a recording and reproducing stylus, detached from the apparatus as a whole.

Fig. 10, is a sectional view of the same.

Fig. 11, is a cross-section on line *x*, *x*, of Figure 9.

Fig. 12, is a vertical section, showing the recording disc and its connection with the driving gear.

Fig. 13, is a sectional view of a part of the driving gear.

Fig. 14, is a section showing the connection of the driven shaft with the support of the recording disc.

Fig. 15. is a sectional view of a centering device employed in this form of apparatus; and Fig. 16 is a plan view, upon a reduced scale, of a disc with a record of sound recorded upon the same, in accordance with my invention.

The general arrangement of the first form of my apparatus is best illustrated in Fig. 1 in which a T shaped base plate A, is shown, upon which two standards H, I, serving as journal bearings for the shaft of drum G, are mounted. The drum G, may be constructed with flanges e, e^1, which project beyond the cylinder surface f, and from the edges of a gap B, left upon the cylinder surface, extend the side walls of box K as shown. A thin layer of felt, or other yielding, elastic substance, is placed upon the cylinder surface, and is bent over the edges of the gap and secured to the side walls of the box K; this layer of elastic material is designed to serve as the support for the record surface both in recording and reproducing.

For recording, I employ a thin strip of paper, parchment, metal or any other suitable substance, which is secured at both ends to bars c, d, in the manner shown in Fig. 7, with reference to a copy of a record; and is then placed upon the elastic support f^1, with the bars c, d, entering into but projecting at both ends beyond the box K, as illustrated in Figs. 1 and 4 with reference to an engraved copy of a record. Bolts g, passing through the projecting ends of bars c, d, are employed to draw the record strip tightly about the drum, and the length of the strip is such, that the ends of the same meet as nearly as practicable upon a straight line z. The record sheet is then prepared to receive the record, by covering its surface with a thin layer of any substance which is easily removed by the action of the recording stylus. I may use lamp-black, which is deposited by placing a smoky flame under the record strip, and by slowly turning the drum until all parts of the strip are covered with the deposit. It is well known that a layer of lampblack thus deposited while it adheres well to the surface of a solid body, is nevertheless, easily removed from the same; it requires only an exceedingly small force to draw a plainly visible line upon such surface owing to the fact that the spicules of carbon, of which lampblack is composed, are only loosely superimposed upon each other, and are exceedingly light. All this has long since been recognised and utilized in the production of phonautographic records, and I take advantage of these facts in my improved method of recording and reproducing sounds.

The diaphragm m, is mounted in a frame n, with its plane at right angles to the axis of drum G. A post O, is fixed to the centre of the diaphragm, and a slot in said post receives one end of stylus S, which is pivoted in the post by a pin t. The stylus extends over and beyond the frame, with its free end barely in contact with the record surface, and is also pivotally supported in a slot in a post p, secured to the frame by means of a pin u, as shown in Figs. 1 and 2.

It will now be seen, that the stylus is in effect, a lever having its fulcrum in the pin u, and that its free end can only move in lines practically parallel to the record surface. If it is now desired to produce a record of sounds, the drum is slowly and uniformly rotated by means of crank L, or by any other suitable means, and sounds are uttered or directed against the diaphragm. Under the impact of the sound waves, the diaphragm is set into vibrations, whereby the free end of the stylus is also caused to vibrate to the right and left of its normal position, removing at the same time an undulating line y, of lamp-black from the record surface, as indicated, greatly exaggerated in Fig. 5. Since, in this operation, the stylus only penetrates a uniform layer of loosely heaped carbon spicules, and barely touches the record surface, it is clear that the slight friction at the free end of the stylus will be uniform, whatever be the amplitude of vibration. Consequently the vibrations of the diaphragm will not be modified or changed by the reaction upon the same of a sensible and varying resistance, as is the case in all other mechanical sound recorders.

Having thus obtained an accurate phonautographic record, the same may be fixed, by applying a thin solution of varnish of any kind, which dries very rapidly, and which does not obliterate or change the record.

If in this process the deposit of lamp black be made thick enough, the line drawn by the stylus would represent a groove of even depth, preserving all the characteristics of the sounds which produced it, and which may be handled and touched with impunity. The latter is then removed from the drum, and may be preserved any length of time without danger of its being disfigured. This record I then copy in solid resisting material, preferably metal, either by the purely mechanical process of engraving, or by chemical deposition, or by photo-engraving. I prefer the last named process, which enables me to produce the most accurate copy of the original record, in copper, nickel or any other metal, without in any way or manner affecting the original record. The copy thus obtained, which may be multiplied to any desired extent, is a grooved wave line upon a strip or sheet of copper, or other metal, as shown in Figs. 1, 4, 6 and 7, and for the reproduction of the recorded sounds, it has the advantage over the ordinary records in tin foil, wax, etc., that it is not sensibly attacked by the reproducing stylus, and will stand an indefinite number of reproductions without the slightest variation in the accuracy and loudness of the reproduced sounds. The copied record is fixed at both ends to the bars *c*, *d*, as shown in Fig. 7, and is placed upon the elastic support f^1, upon the drum, in the same manner as has been described with reference to the original record strip, and as is illustrated in Figs. 1 and 4. Care must be taken, that the two ends of the undulatory groove *y*, meet exactly, as will be readily understood.

This condition of the apparatus is shown in Fig. 1 with the engraven record upon the drum, and the free end of the stylus entering the undulatory groove.

If now the drum is rotated with uniform speed, the end of the stylus will be forced to follow the undulations of the groove *y*, and the diaphragm will be vibrated positively in both directions in strict accordance therewith, and will therefore, reproduce the exact sounds which originally produced the record. This peculiarity of positive vibratory movement in both directions of the diaphragm, is a feature which also distinguishes my method and my apparatus, from others heretofore used.

In the phonograph and graphophone, the end of the reproducing stylus which bears upon the indented or engraved record, has a vertical upward and downward movement; it is forced upwardly in a positive manner by riding over the elevated portion of the record, but its downward movement is effected solely by the elastic force of the diaphragm, which latter is always under tension. In my improved apparatus, the stylus travels in a groove of even depth and is moved positively in both directions; it does not depend upon the elasticity of the diaphragm for its movement in one direction. This I consider to be an advantage, since by this method the whole movement of the diaphragm is positively controlled by the record, and is not affected or modified by the physical conditions of the diaphragm which conditions necessarily vary from time to time, and constitute some of the causes of imperfect reproduction of recorded sounds.

In practising my method of recording and reproducing sounds, I am not limited to the use of the identical apparatus herein shown and described; this apparatus may be varied indefinitely without seriously impairing its utility for the purposes in view.

Thus, it is not absolutely necessary that a diaphragm should be used for receiving the impact of sound waves in recording and for remitting sounds in reproducing; any sonorous body, of whatever shape and material, may be used in lieu of a diaphragm proper. The recording surface need not be mounted upon a drum, but may be supported in any suitable manner upon a support of any description which is adapted to move the same under the stylus evenly and with approximately uniform speed.

Nor do I confine myself to the use of lamp-black as a substratum for the phonautographic record, although I have found this substance to yield excellent results; any other substance which adheres well to the support, and may at the same time be removed from the same with a minimum force, may be employed.

Thus far I have described a method of recording and reproducing sounds which consists in first causing the sounds to inscribe themselves upon a layer of non-resisting material in a manner substantially like that practised by the well known

Leon Scott Phonautograph; then copying the phonautographic record in solid resisting material, preferably by the photo-engraving process, and then reproducing the sounds from the solid copy of the record.

The original record as well as the copy of the same, is obtained as has been seen, as an undulatory line of even depth, as distinguished from a line of varying depth obtained by the ordinary Phonograph and by the Graphophone.

In the second form of my invention, I retain all the fundamental features of my gramophone, but introduce certain novel features both in the process and in the apparatus, which render the attainment of the objects of a sound recorder and reproducer still more certain and more perfect.

In the original form of my gramophone above described, I employ a curved (cylindrical) surface upon which the non-resisting medium used for recording is supported; this has the disadvantage that, for the purpose of copying the record by the photo-engraving process, such surface has to be first straightened, and the flat copy obtained from the same has to be bent again to the original cylindrical form of the record surface. This involves delicate and tedious manipulations, which I avoid in my second form of apparatus, by inscribing the record of sounds upon a flat plate, and I further improve the process by arranging that flat plate horizontally, and by inscribing the record upon the under surface of the same, whereby the material removed by the recording stylus drops away from the plate, and leaves the undulatory groove of even depth clean and well defined; whereas by the method as practised with the apparatus above described, the material removed by the stylus accumulates in and about the adjacent grooves.

I further improve the process, by using a transparent plate as a support for the non-resisting medium; this plate is therefore made either of glass or some other like substance, whereby I secure several important advantages. The most important of these advantages is, that it enables me to work with parallel transmitted rays of light in the subsequent process of photo-engraving, in which the original record is thus used as a negative; and another important advantage is, the reduction of the friction of the stylus upon the support, to a minimum.

The process is further improved by the employment of a new recording medium. In the original process I use a layer of lamp-black, pure and simple, and this substance is well adapted for the purpose, on account of the slight coherence of the particles; but by reason of the floculent nature of this substance, the lines drawn upon it are more or less ragged, as can be observed under the microscope, and the photo-engraving obtained from such record displays all the defects of the original. In my improved second process, I employ a layer of a semi-fluid ink or paint, of such consistency and thickness that it will neither subside nor flow spontaneously. Such ink is practically structureless, and the lines drawn upon it are exceedingly sharp and reveal no ragged edges under a powerful microscope, and the photo-engraving from such record is far superior to a like copy from a record produced under the former process.

Referring now to Figs. 8 to 16, in which the details are marked by numerals, there is a platform 1, suitably supported, and upon this platform are mounted the operative parts of the apparatus. A metallic plate 2, provided with a longitudinal rib 3, is secured upon the platform, and standards 4, 4^1, mounted upon plate 2, are provided with a nut bearing 5, and a smooth bearing 5^1, respectively, for the shaft 6, which extends through these bearings as shown. One half, more or less of this shaft, is screw threaded as shown, and enters the nut bearing 5, and at a point near the middle said shaft passes loosely through a movable support 7, the position of which upon the shaft is determined by two collars 8, 8, as indicated in Fig. 14. The support 7, serves as a bearing for a bevel gear 9, which is centrally perforated and widens out into a circular flange 10. Upon its underside, the bevel gear 9, is recessed, and said recess fits loosely over the upper end of support 7; a screw 11 Fig. 12 passing loosely through the central perforation of bevel gear 9, screws into the head of support 7, so that the bevel gear can rotate about its axis, which coincides with the axis of screw 11. Two screw pins 12, 12, which may be either fixed or removable, project at

diametrically opposite points, from flange 10, and are designed to pass through two similarly located holes in a glass plate 13, as will be more fully described hereinafter. A bevel gear 14, fixed upon shaft 6, engages bevel gear 9, but provision is made for releasing gear 14, from the shaft if desired, for a purpose which will be explained further on. As stated above, the screw threaded portion of shaft 6, passes through nut-bearing 5, and it will now be clear, that if shaft 6 is rotated, bevel gear 9, with its flange 10, will likewise rotate, and will at the same time advance in a straight line; since shaft 6, screwing into or out of its nut-bearing 5, will carry bevel gear 14, and support 7, with it. From the bottom of support 7, two lugs 15, 15,—one on each side of rib 3, of plate 2, serve to guide the support with the parts attached thereto, in the line of said rib, which is of course parallel to shaft 6. A part of the smooth portion of shaft 6, has a longitudinal groove 16, extending to the right hand end of the shaft (as seen in Figs. 8 and 13), and a sleeve 17, loosely fitting this portion of the shaft, has a pin 18, the end of which engages groove 16, as shown in Fig. 13, so that the shaft is free to slide longitudinally through sleeve 17, and will rotate with the same if the latter is rotated.

Sleeve 17, is fitted into bearing 5^1, of standard 4^1, so as to rotate within the same, and upon that part of the sleeve which projects beyond the bearing, is keyed the compound gear 19. The latter is composed of a pinion 20, and a bevel gear 21; and a rather large bevel wheel 22, mounted upon a shaft 23, below platform 1, meshes with pinion 20.

A small bevel gear 24, meshes with gear wheel 21, and to the shaft of gear 24, are secured fans 25, which are thus driven at a high speed and serve as a regulator, as will be readily understood by those skilled in the art.

A weight 26, is suspended by cords or chains 27, from shaft 23, and if said shaft is turned by a crank 28, or otherwise, in one direction, the cords or chains are wound upon the same, as indicated in Fig. 8, and the weight 26, is raised up toward the platform. If on the other hand, the weight is allowed to descend, it will rotate shaft 23, this in turn will rotate gear wheel 22, which meshing with pinion 20, will rotate the latter and the connected shaft 6, and in the manner hereinbefore described, the support 7, will receive a rectilinear motion, while flange 10, upon bevel gear 9, will both rotate and move in a straight line. For every complete revolution of bevel gear 14, support 7, and bevel gear 9, with its connected flange 10, will be moved in the line of a diameter, a distance equal to the pitch of the screw threads upon shaft 6; and it will now be understood, that if a plate 13, is fixed to flange 10, and a fixed pencil or stylus be lightly pressed upon the plane surface of said plate, a spiral line will be drawn upon the plate. The recording stylus 29, is mounted upon a diaphragm 30, substantially in the manner shown in and described with reference to Figs. 1 and 2. The diaphragm itself, which may be of any suitable sonorous material, is mounted in a case 31, Fig. 10, a rigid tube 32, projecting from one side of the case communicating with a flexible tube 33, and with a mouth or ear-piece 34. The tube is clamped and may be adjusted in the direction of its length in a ring 35, formed at the end of a rod 36, which is adjustable in a support 37; and the latter is again adjustable vertically in a standard 38, mounted upon platform 1. A metal post 39, is fixed to the centre of the diaphragm, as shown, and its free end has an axial slot 40, into which a soft rubber tube 41, is forced and flattened. The free end of the soft rubber tube receives the stylus 29, which may be of metal or any other hard and fairly elastic material.

Preferably, the stylus is made of a flat strip of phosphor bronze, extending radially over the face of casing 31, and some distance beyond the edge of the same. At its free end, the stylus is reduced to a point, and is curved upwardly, and by turning the diaphragm case about the axis of tube 32, or by turning rod 36, in its bearing 37, or by adjusting the latter upon bracket 38, the point of the stylus may be brought into light contact with the lower face of disc 13, at a point in diameter of said disc which is parallel with shaft 6. Near the middle of its length, a hole is produced through the stylus, and a pin 42, formed at one end of a metal block 43, passes through said

hole, and into the central bore in a similar block 44. Between each block, and the adjacent face of the stylus, a soft rubber washer 45, is inserted, and the two blocks are forced together and are made to clamp the stylus between the rubber washers, by means of the pointed screws 46, working in the supports 47. The screws 46, 46, thus constitute the pivotal supports of the stylus, which is a true two-armed lever; a piece of soft rubber tubing 48, is inserted between the outer arm of this lever and the casing 31, and another piece of soft rubber tubing 49, is slipped over the stylus between the elastic support 48, and the outer end. Thus it will be seen that the stylus is elastically supported and amply dampened, and that if the diaphragm vibrates under the impact of sound waves, the free end of the stylus will move to the right and to the left of its position of rest, and parallel to the face of disc 13. The disc 13, is preferably made of glass, it is of suitable diameter and thickness, and has two holes 12^1, 12^1, Fig. 12, corresponding to the pins 12, 12, projecting from flange 10, and is placed in position upon said flange, with the pins entering the holes; the nuts 50, 50, are then screwed down, whereby the glass disc is securely clamped.

The method of recording and reproducing recorded sounds by means of this apparatus will now be easily understood. As has been stated above, the non-resisting material upon which the sound record or phonautogram is produced, is a semi-fluid, and I can use for this purpose any ink, as for instance printer's ink, of the required consistency; an even layer of this ink may be spread over the under surface of the glass disc, in any suitable manner, as for instance by means of a brush or roller, while the disc is slowly turned. But I prefer to produce the ink directly upon the disc itself, and I proceed in the following manner.

The under surface of the glass disc is first carefully polished and dried, and is then covered with a thin film of oil by means of a camel-hair brush; this is done while the disc is rotated with moderate speed. Any oil or fat may be used, but I have found linseed oil specially adapted for the purpose. A smoky flame is then held under the glass plate while the latter is slowly rotated, whereby the lamp-black ascending from the flame is intercepted by the plate and becomes deposited upon the same in a very fine layer, which, however, is instantly absorbed by and mixes intimately with the thin layer of oil, thus forming a black amorphous ink covering the under surface of the glass disc in an even, exceedingly thin layer.

The coating of ink, thus directly formed upon the disc has just the consistency and the thickness required: it will not flow spontaneously, and while it adheres well to the glass plate it requires only a minimum force to remove it from the same, and the point of the stylus in its passage through the substance of the ink experiences no perceptible resistance.

The disc is now ready to receive the phonautogram, and it is moved to the position shown in Fig. 8, with the point of the stylus near the outer edge; the point of the stylus is then adjusted into light contact with the disc, so that the coat of ink is barely penetrated by the same, and the weight 26, is allowed to descend, and to rotate shaft 6, in the manner hereinbefore described. If now, the stylus remained immovable, it would describe upon the under surface of the disc a smooth spiral, the convolutions of which continuously decrease toward the center of the disc; the pitch of the spiral is determined by the pitch of the screw upon shaft 6, and by the relative angular velocities of said shaft and of bevel gear 9, and may in practice be made as small as $\frac{1}{250}$ of an inch.

If now, during the progress of the disc, sound waves are directed against the diaphragm, through the mouth piece 34, and tubes 33, and 32, the stylus will vibrate to the right and left of the spiral line, inscribing upon the disc an undulatory line of even depth, which line will truly and accurately represent the sounds uttered against the diaphragm. The stylus removes a very sharp line of ink from the disc, leaving the latter quite transparent at this line, while it is quite opaque and will not transmit light at the places not touched by the stylus; the ink removed by the stylus drops away from the disc, as stated above, and does not accumulate in and about the grooves.

An approximate idea of the phonautogram thus produced can be obtained by inspection of Fig. 16, which represents an undulatory spiral line upon a disc with the pitch of the spiral greatly exaggerated. In the drawing, the undulatory line appears black upon a white ground, while in fact the line is transparent upon a black ground.

The phonautogram may extend to within a short distance from the edge of flange 10, and in practice the cords or chains 27, 27, are made just long enough to drive the disk up to that limit, or the apparatus is mounted at the proper height above the ground so that the weight will be arrested before the limit of progress of the disc is reached. Bevel gear 14, is then disengaged from bevel gear 9, by unclamping the same from shaft 6, and sliding it upon the same a short distance to the left hand (in the view shown in Fig. 8) and the disc is then given a single rotation by hand, whereby the stylus describes a true circle 51, Fig. 16 upon the disc. This circle, which I call the centering circle, is afterwards utilized, as will presently appear.

The glass disc, with the sound record and centering circle upon the same, is now removed, and the record may be fixed by applying a thin coat of varnish; it may then be handled with impunity.

From this record I produce a copy in copper or any other metal, by the process of photo-engraving and in this process I use the original record as a negative, which enables me to work by transmitted light, and with parallel rays; the copy thus produced will have the exact size of the original, as is well understood by those skilled in the art.

In the photo-engraved copy, the sound record appears as an undulatory line of even depth upon a solid metal disc, and the centering circle 51 is reproduced in the same manner.

For reproducing the original sounds, the centre of the centering circle is determined by well known simple geometrical constructions, and a small hole is drilled through that centre, which hole corresponds to the mathematical axis about which the glass disc had been rotated, and also marks the axis about which the metal disc must be rotated by the apparatus shown, in order that the pointed stylus applied to the starting point of the record may follow the same from beginning to end.

Two holes corresponding to the holes 12^1, 12^1, in the glass disc, are also made in the metal disc, but these holes are preferably made large enough to permit the disc to be adjusted in either direction when placed upon flange 10. Before this is done, a well fitting cylindrical block 52, is placed into that part of the cylindrical hole through the common centre of flange 10, and bevel gear 9, which is occupied by the head of screw 11, as shown in Fig. 15; this block which I call the centering block, has a fine axial hole 53 which corresponds exactly to the mathematical axis of rotation of bevel gear 9.

If now the photo-engraved copy of the record is placed upon flange 10, with pins 12, 12, passing through corresponding holes in the metal plate—a fine pin, say a sewing needle, is passed through the centering holes in the disc and in block 52, and the clamp nuts 50 are tightly screwed down. By this simple process, the metallic copy of the original record is safely and quickly centered in position; the stylus is then adjusted with its point in engagement with the outer end of the record groove, and the weight 26 is allowed to descend.

It will now be clear that the stylus wil be forced positively to follow the undulations of the record, and that the diaphragm vibrating under the stylus will emit the same sounds which produced the original record; which sounds can be distinctly heard at the ear-piece 34.

In place of the metallic copy of the original record, I can use a copy made of sealing wax, which is produced by pressing a metal plate, having the record in raised lines, upon a cake or plate of sealing wax which is first softened by heat. The metallic record may thus be preserved indefinitely without being used directly for the reproduction of the recorded sounds, but, simply as a stamp for multiplying the record quickly and cheaply for immediate use.

While I have found the process of photo-engraving to yield admirable copies of the

phonautographic record, I do not mean to limit myself to this process to the exclusion of other processes for copying and multiplying the original record in solid resisting material: and it will be readily understood that the details of construction of my apparatus and the manipulation of the same may be greatly varied without departing from the fundamental idea of my invention.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. The method or process of recording and reproducing spoken words and other sounds, which consists in first drawing an undulatory line of even depth in a travelling layer of non-resisting material, by and in accordance with sound vibrations; then producing the record thus obtained, in solid, resisting material, and finally imparting vibrations to a sonorous body, by and in accordance with the resisting record, substantially as described.

2. The method or process of reproducing sounds recorded phonoautographically, which consists in copying the phonautographic record in solid resisting material, and then imparting vibrations to a sonorous body, by and in accordance with the copy of the original record, substantially as described.

3. The method or process of reproducing sounds recorded phonautographically, which consists in copying the phonautographic record in solid resisting material by the process of photo-engraving and then imparting positive to-and-fro movements to a sonorous body, by and in accordance with a copy of the original record, substantially as described.

4. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth of a deposit of ink from a travelling plate of glass, by and in accordance with sound vibrations, substantially as described.

5. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth, of a deposit of amorphous, opaque material, from a travelling support of glass by and in accordance with sound vibrations, substantially as described.

6. The method of producing a transparent phonautogram, which consists in removing an undulatory line of even depth, extending along a volute described about a given point, of a deposit of amorphous and opaque material from a rotating disc of glass, by and in accordance with sound vibrations, substantially as described.

7. The method of producing a layer of semi-fluid ink upon a phonautographic support, which consists in first applying a coat of oil or other fat upon the support, and then depositing upon the oiled surface a thin layer of lampblack, substantially as described.

8. As a step in the method of photo-engraving a transparent record of sounds the process of photographing the same, which consists in applying such record directly upon a plate sensitive to light, and exposing the same to actinic action, substantially as described.

9. In a gramophone, the combination of a sound receiving diaphragm or other sonorous body; with a pivoted stylus controlled by a diaphragm, and controlling the same, and a support adapted to carry a phonautographic record sheet or a copy of such record, in solid resisting material, travelling in the plane of vibration of the point of the stylus, substantially as described.

10. In an apparatus for mechanically recording and reproducing recorded sounds, the combination of a sonorous body and a recording and reproducing stylus, mutually controlling each other, with a support for recording and reproducing strips, travelling in the plane of vibration of the end of the stylus, substantially as described.

11. In a gramophone, the combination of a travelling phonautographic record, consisting of a strip or sheet of solid resisting material, having upon its surface undulatory grooves of even depth, similar in form to the undulations of sound waves; with a stylus engaging the grooves of the record, and a diaphragm or other sonorous body controlled by the stylus, substantially as described.

12. In a gramophone, the combination of a sonorous diaphragm and a pivoted stylus;

with an elastic connection between the diaphragmandstylus,and an elastic reactionary dampening support for the free arm of the stylus, substantially as described.

13. In a gramophone, the combination of a diaghragm and pivoted stylus; with an elastic connection between the diaghragm and the stylus, substantially as described.

14. In a gramophone, the combination of a horizontal travelling support for the record surface; with a vibratory diaphragm and a recording stylus bearing upon the under surface of the record surface, substantially as described.

15. As an article of manufacture, a phonautographic record of spoken words or other sounds, which consists of a flexible strip or sheet of solid resisting material, having upon its surface a groove of even depth, undulating to represent sound vibrations, substantially as described.

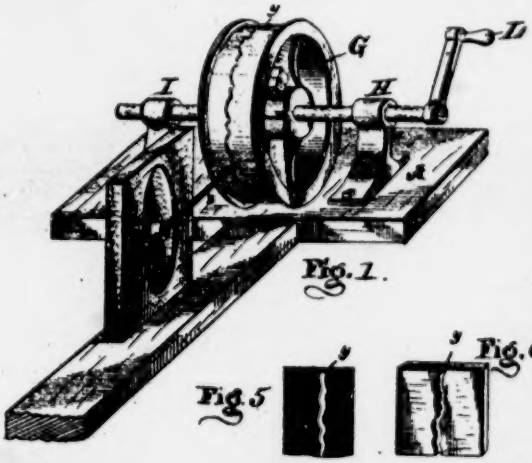
Dated this 8th day of November 1887.

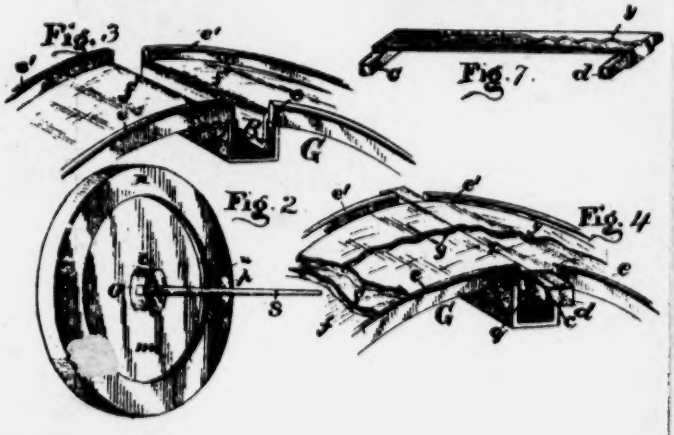
PHILIP M. JUSTICE,
55 and 56, Chancery Lane, London,
Applicant's Agent.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[C. 9190—125—4/1900.]

(4th Edition)

[This Drawing is a reproduction of the Original on a reduced scale.]





SHEET 1.

SHEET 2.

Fig. 8.

Fig. 13.

Malby & Sons, Photo Litho.

Malby&Sons, Phot.

[Reduced from the Original.]

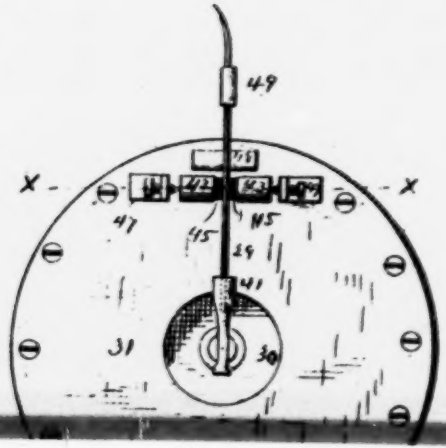


Fig. 9.

Fig. 10

[This Drawing is a full-size reproduction of the Original.]

Fig. 9.

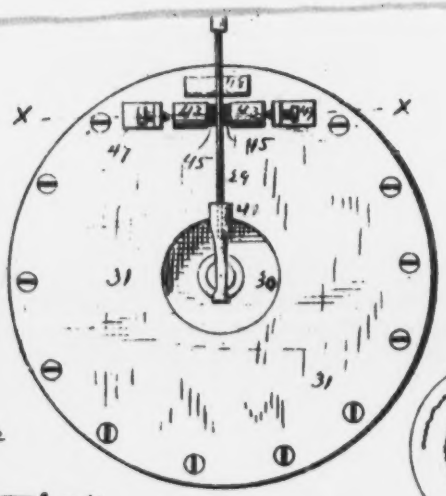


Fig. 16.

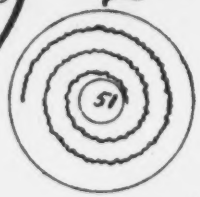


Fig. 15.

Fig. 11.

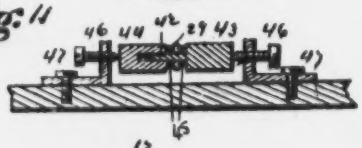


Fig. 14.

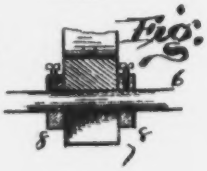


Fig. 17.

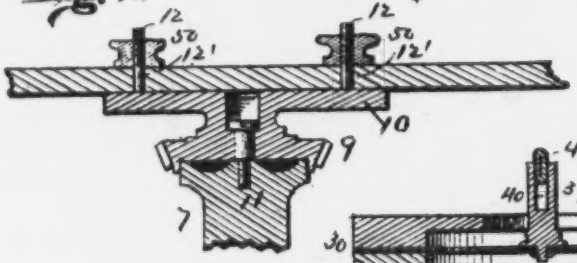
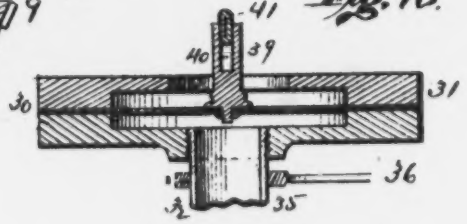


Fig. 10.



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N° 7204 A.D. 1888

Date of Application, 15th May, 1888—Accepted, 15th June, 1888

COMPLETE SPECIFICATION.

An Improved Process of Recording Sounds for Reproduction.

I, EMILE BERLINER of Columbia Road, Washington in the District of Columbia, United States of America, Electrician, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

In the Specification of previous Letters Patent granted to me dated the 8th November 1887, and numbered 15,232 I have described a method of and apparatus for recording and reproducing spoken words and other sounds ; and in connection therewith, and as a part thereof, I have described a process of producing a record of sound waves in solid resisting material by photo-engraving, the phonautographic record of such sound waves having first been produced as an undulatory line of even depth in a travelling layer of non-resisting material.

My present invention consists of an improvement on such method or process of recording sounds, and it has for its object the production of a record of sound waves in solid resisting material, principally metal, by the process of direct etching ; whereby a solid unchangeable sound record is obtained more cheaply and more rapidly, either upon a flat or upon a curved surface, without the delicate and intricate manipulations incidental to the process of photo-engraving. All this will more fully appear from the following detailed description, in which I shall freely refer to what is shown and described in my aforesaid specification as a part of the now common or public knowledge.

In accordance with the rules laid down in said Specification, I produced a phonautographic record upon a travelling layer of lamp-black, or other non-resisting material ; then this phonautographic record was transferred by photo-engraving upon metal, and the metallic record thus obtained was used for reproducing the recorded sounds. In the course of my experiments I have found that in place of lamp-black, other substances may be used as the non-resisting medium for receiving the original phonautographic record, and I have also found that among the substances are such as will resist the chemical action of acids, but which offer no perceptible mechanical resistance to the movement of the recording stylus.

Upon this discovery, my present invention is based, and it consists, broadly speaking, in producing a phonautographic record through a film of a suitable etching ground deposited upon a travelling surface of resisting material, such as metal or

glass; and then subjecting said surface to the action of a suitable etching agent which attacks said surface at the places only where the etching ground has been removed by the recording stylus.

The etching ground, which is to serve as the non-resisting medium for the phonautographic record, I prepare by dissolving beeswax, paraffine, or other like substance, in a suitable solvent. By preference, I use beeswax, and dissolve the same in benzine so as to obtain a saturated solution. This solution is filtered, and care is taken to exclude, as much as possible, all dust which is always present in the ambient air.

In making the solution of beeswax, I preferably use a much greater quantity of the latter than can be dissolved in benzine at the ordinary temperature, since experience has shown that the ground thus obtained is more delicate and at the same time resists the action of the etching-agent better than when the whole of the is dissolved.

The surface which is intended to receive this ground, which may be a flat disc, or a cylinder of metal or glass, it should be smoothly polished, and must be cleansed and dried. The wax solution is then poured over this surface so as to cover the same at all points, and the solvent is then allowed to evaporate, which it does in one or two minutes. An exceedingly fine film of wax then remains adhering to the surface of the metal or glass, and the consistency of this wax is such that it offers no perceptible mechanical resistance to the action of the recording stylus, while at the same time, it resists the chemical action of ordinary etching agents.

In this respect, the film of wax deposited from the solution is quite different from a layer of wax produced by melting; the latter has such consistency, and adheres to the supporting surface with such tenacity, that considerable force must be used to penetrate the same and remove it from its support, while the wax film deposited in the manner described is so delicate, that a camels hair brush will disturb it perceptibly. Partly on account of the too great sensitiveness of a single film, and also as an additional protection against the action of the acids employed in the subsequent etching, I ordinarily, but not necessarily, apply a second coating of the solution, which when dry, leaves a film of wax of such thickness, as I have found to answer all requirements.

A plate or cylinder thus prepared, may be preserved indefinitely, and is at all times in good condition to receive the phonautographic record. Such record is produced by moving the prepared surface under a stylus actuated by sound waves to remove an undulatory line of the non-resisting film from its support, whereby the latter is laid bare along the said line; as is fully described in my specification above referred to; and as is now well understood by those skilled in the art.

The plate or cylinder is then subjected to the action of a suitable etching agent, the nature of which varies according to the material of the support. For metals, such as zinc, copper or brass, diluted nitric, hydrochloric or other acid is used; while for glass or other like materials fluoric acid or the fumes of the same must be used. In either case I obtain upon the support, within a few minutes, an undulatory groove of even depth representing the sound waves which acted upon the recording stylus; and this groove is of sufficient depth to guide and control a reproducing stylus, in the manner set forth in my former patent specification.

By the use of the ordinary etching agents, the difficulty arises, that soon after the action upon the metal base has commenced, the hydrogen, which is thereby set free, accumulates in small bubbles along the traced lines and to both sides of the same, forming a bar against the further action of the acid. In the ordinary process of etching, this difficulty is overcome by brushing the surface of the plate from time to time, whereby the gas bubbles are removed. This would be quite impracticable with the delicate etching ground which I employ, since no brush could be found that would be delicate enough to prevent the partial removal of the etching ground, and thereby the accession of the acid to portions of the plate which must remain unaffected. I, therefore, make use of an etching agent which consumes the hydrogen as soon as the same is set free, and I have found that when the plate is of zinc, chromic acid,

or its substantial equivalents when used as the etching agent, will effectively prevent the formation and accumulation of gas bubbles.

I do not, however, confine myself to any particular mode of etching, the ordinary process being followed in this respect; the same is true of the practice of re-biting, if a single exposure to the etching agent should prove to be insufficient to produce a groove of sufficient depth. From a record produced in the manner described any number of copies may be obtained by electro deposition, especially if the original record is etched in metal. In that case, however, I have found it advisable to burnish the original record groove before the plate or cylinder is placed into the depositing bath.

This is a very simple process, and consists in holding and gently pressing a pointed burnishing tool in the record groove, while the plate or cylinder is rotated; the tool is held in one hand, while the plate or cylinder is rotated by the other. In this manner the burnishing tool is guided through the record groove from one end to the other, and the slightly granular structure of the etched groove is thus polished without losing any of its essential characteristics. This process occupies only a very few minutes, but though it improves the galvano-plastic copy obtained from the original record, it is not absolutely essential. In place of a special burnishing tool, the reproducing stylus may be used, the point of which is ordinarily of hard metal, such as iridium; so that the burnishing is effected by simply using the record once or twice for reproducing the recorded sounds, in the ordinary manner.

It has been stated above, that the dissolved and filtered wax or other ground, should be carefully protected against dust, which is always present in the surrounding air, and it is obvious that the same precaution should also be taken with respect to the plate or cylinder upon which the record is made. But experience has shown that it is almost impossible to guard effectually against the accession of fine filamentary particles of dust to and into the body of the tracing or etching ground. These dust particles are so fine that they cannot, as a rule, be detected by the most searching inspection of the prepared plate; but they become very conspicuous and a very serious source of annoyance when the record is made. As the recording stylus passes through the wax or other ground, a fine undulatory line of the latter is removed, and the removed material drops away from the stylus as soon as removed, so that the point of the stylus always remains clean. This, however, is only the case when the ground is free of filamentary impurities; but if filaments of dust are imbedded in the ground, they adhere to the stylus and together with a coating of the ground are dragged through newly formed grooves, whereby the latter become uneven and receive ragged edges which seriously impair the accuracy of the record.

I have discovered an effective means for overcoming this difficulty, and it consists in simply moistening the record surface with a fluid that slightly adheres to the ground, and keeping it moist while the record is being made. I have found strong alcohol to be very effective for this purpose, when wax is used as the tracing ground, and it is used by pouring it over the ground just before the plate or cylinder is started to move under the recording stylus. The alcohol evaporates rapidly, but not so rapidly as to disappear entirely before the record is finished; and this record now shows no trace of inequality; the lines being as sharp and well defined as if cut by a graver. The point of the stylus remains quite clean, and it seems as if the filamentary particles had disappeared.

I have no definite theory by which to explain this surprising result. It is possible that the exceedingly fine dust particles are forced against the walls of the grooves and are there held, when the ground is in the peculiar state of dampness which it receives when alcohol is poured over the same; it is also possible that these particles of dust, being probably of organic matter, are dissolved by the alcohol; and it is also possible that both causes operate to keep the point of the stylus clean so as to make a sharp and well defined record. But whatever be the mode of action of the alcohol poured over the ground, its effect is highly beneficial, and its use constitutes one of my improvements.

The film of ground which I employ is so exceedingly thin, that it is practically

colorless and transparent; the record is for this reason almost invisible to the naked eye. In some cases, however, it is desirable to be able to inspect and scrutinize the record before it is exposed to the action of the etching agent, or to watch the progress of the record, and for this reason it is advisable to slightly color the ground before the record is made.

I accomplish this by exposing the record surface, after the etching ground has been applied, to the cold smoke of a flame, preferably to the smoke of the flame of burning camphor, whereby a very light deposit of lamp-black is made upon the ground, and whereby the tracings which are afterwards made by the stylus become visible as pale lines upon a grey ground.

Care must be taken in this process to hold the plate or cylinder at such distance from the flame, that the heat of the latter does not perceptibly affect the wax ground, so that the latter does not melt, whereby its peculiar consistency that adapts it to be impressed by a minimum tracing force, would be changed.

The application of alcohol or other dampening fluid, as above described, does not disturb the fine layer of lampblack and acts, in addition to its principal function of keeping the point of the stylus clean, and the tracings sharpe and well defined, also as a lubricator, that diminishes the friction of the stylus.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:—

1. The method or process of producing a record of sound waves in solid, resisting material for reproduction of the recorded sounds, which consists in covering the surface of such material with a film of etching ground that offers no perceptible mechanical resistance; then making a phonautographic record upon and through the etching ground, and then exposing the record to the action of a suitable etching agent substantially as described.

2. The method or process of producing a record of sound waves in solid, resisting material for reproduction of the recorded sounds, which consists in depositing upon the surface of such material a film of wax from a solution of the same in a suitable menstruum; then making a phonautographic record upon and through the wax film, and then exposing the record to the action of a suitable etching agent; substantially as described.

3. The method or process of producing a record of sound waves in solid, resisting material for reproduction of the recorded sounds, which consists in depositing upon the surface of such material a film of wax from a solution of the same in benzine, then making a phonautographic record upon and through the wax film, and then exposing the record to the action of a suitable etching agent; substantially as described.

4. The method or process of preparing solid surfaces for the reception of a phonautographic record, which consists in depositing upon said surfaces a film of tracing or etching ground, and then moistening such film with an adhering film; substantially as described.

5. The method or process of preparing solid surfaces for the reception of a phonautographic record, which consists in depositing upon said surfaces a film of wax, and then moistening the wax film with alcohol; substantially as described.

Dated this 15th day of May 1888.

PHILIP M. JUSTICE,
55 & 56, Chancery Lane, London,
Agent for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[G. 9274—125—5/1906.]

1594 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY and United States Gramophone Company, Complainants, vs. LEEDS & CATLIN COMPANY, Defendant.	In Equity, No. 8797. On Patent No. 534,543.

1595

To the Honorable the Judges of the Circuit Court of the United States for the Second Circuit in and for the Southern District of New York:

The petition of the Leeds & Catlin Company, defendant herein, respectively shows:

First. That heretofore in July, 1904, the complainants filed their bill of complaint against the defendant herein, that thereafter defendant duly appeared on the August, 1904, rule day. Defendant's demurrer to the bill of complaint having been overruled, on December 21, 1905, defend-
1596 ant filed its answer to the bill of complaint and complainants filed their replication on the February, 1906, rule day; that thereafter complainants moved for a preliminary injunction against defendant and on May 2, 1906, an order was entered herein directing a writ of preliminary injunction to issue herein restraining the defendant, as provided in said order, until further order of the Court. Affidavits and exhibits were presented to the Court by complainants and defendant upon said motion.

Second. Wherefore, your petitioner, Leeds &

Catlin Company, feeling itself aggrieved by the entry of said order on May 2, 1906, hereby appeals therefrom to the Circuit Court of Appeals of the United States in and for the Second Circuit for the reasons specified in the assignment of errors, which is filed herewith, and prays that this appeal may be allowed and that a duly authenticated transcript of said order and of the record and other proceedings thereto relating upon which said order was made, together with all exhibits used upon said motion, may be transmitted forthwith to the United States Circuit Court of Appeals for the Second Circuit for review therein. 1597

Dated May 4, 1906.

LEEDS & CATLIN COMPANY, 1598

By Louis Hicks,

Solicitor and Counsel.

And now to-wit, on this 10th day of May, 1906, it is ordered that the above appeal be allowed as prayed for.

E. HENRY LACOMBE,

U. S. Circuit Judge.

Service of a copy of within petition and order on this 12th day of May, 1906, is hereby admitted.

STIMSON & WILLIAMS,

Per H. P.

Solicitors for Complainants. 1599

Filed May 12th, 1906.

1600 CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, and United States Gram-o-Phone Company, Complainants, vs. LEEDS & CATLIN COMPANY, Defendant.	In Equity. No. 8797. On Patent No. 534,543.

1601

To the Honorable the Judges of the Circuit Court of the United States for the Second Circuit in and for the Southern District of New York:

And now comes the above-named defendant, Leeds & Catlin Company, by its solicitor with its petition for appeal from the order or decree entered in this cause May 2, 1906, and designated in the said petition for appeal and makes and files the following assignment of errors:

The Circuit Court erred in the following particulars:

1602 1. In not holding that the patent in suit, No. 534543, expired with the prior German Patent No. 53622, of November 20, 1889.

2. In not holding that claim 5 of the patent in suit, No. 534543, expired with the prior German Patent No. 53622, of November 20, 1889.

3. In not holding that claim 35 of the patent in suit, No. 534543, expired with the expiration of the prior German Patent, No. 53622, of November 20, 1889.

4. In not holding that the patent in suit, No. 534543, expired with the prior French Patent No. 207090, of July 19, 1890. 1603

5. In not holding that claim 5 of the patent in suit, No. 534543, expired with the prior French Patent No. 207090, of July 19, 1890.

6. In not holding that claim 35 of the patent in suit, No. 534543, expired with the expiration of the prior French Patent No. 207090, of July 19, 1890.

7. In not holding that the patent in suit, No. 534543, including Claims 5 and 35, expired with English Patent No. 15232, of November 8, 1887.

8. In not holding that the patent in suit, No. 534543, including Claims 5 and 35, expired with German Patent No. 45048, of November 8, 1887. 1604

9. In not holding that the patent in suit, No. 534543, including Claims 5 and 35, expired with French Patent No. 186827, of November 8, 1887.

10. In not holding that Berliner was not the inventor of the invention set forth in Claims 5 and 35 of the patent in suit.

11. In not holding that the invention of Claims 5 and 35 of the patent in suit, No. 534543, was anticipated by Werner Suess in Canadian Patent No. 41901, of February 11, 1893. 1605

12. In not holding that Berliner had abandoned the invention claimed in Claims 5 and 35 of the patent in suit, No. 534543, before he applied for a patent therefor.

13. In not holding that Berliner had abandoned the invention claimed in Claims 5 and 35 of the patent in suit, No. 534543, before the patent was issued.

1606 14. In not holding that Claims 5 and 35 of the patent in suit, No. 534543, should be limited to Berliner's improvements in the details of construction of his reproducer.

15. In not holding that defendant's devices do not infringe Claims 5 and 35 of the patent in suit, No. 534543.

16. In not holding that the patent in suit, No. 534543, expired February 11, 1899, with the expiration of the term of six years for which the prior Canadian Patent, No. 41901, of February 11, 1893, was granted.

1607 17. In not holding that Claims 5 and 35 of the patent in suit, No. 534543, were anticipated by English Patent No. 1644, of 1878, to Edison.

18. In not holding that the patent in suit, No. 534543, was not fairly in controversy in the prior suit between these complainants and the American Graphophone Company, and that the adjudication in that suit formed no proper basis for a preliminary injunction.

19. In not holding that at the time of the hearing of the motion for preliminary injunction defendant was entitled to have the cause heard upon
1608 the pleadings and the bill dismissed.

20. In not holding that the patent in suit, No. 534543, had expired before the commencement of this suit.

21. In not holding that the patent in suit, No. 534543, had expired before the making of the motion for preliminary injunction and the making of the order entered May 2, 1906, and hereby appealed from.

22. In not denying the motion for preliminary injunction.

23. In not dismissing the bill of complaint upon the hearing of the motion for preliminary injunction. 1609

24. In not holding that Claims 5 and 35 of the patent in suit, No. 534543, are and always have been invalid by reason of more than two years public prior use in the United States by Berliner before the date of the filing of his application therefor.

25. In not holding that Claims 5 and 35 of the patent in suit No. 534543, are and always have been invalid by reason of more than two years public prior use in the United States by T. Commerford Martin before the date of the filing of the application therefor. 1610

26. In not holding that in view of the state of the prior art Claim 5 of the patent in suit, No. 534543, is void for lack of invention.

27. In not holding that in view of the state of the prior art Claim 35 of the patent in suit, No. 534543, is void for lack of invention.

28. In not holding that in view of the prior art Claim 5 should be limited to a method of reproducing sounds wherein the stylus is vibrated substantially as described in the specification of the patent in suit, No. 534543, and shown in figures 6 and 7 thereof. 1611

29. In not holding that in view of the prior art Claim 35 of the patent in suit, No. 534543, should be limited to a sound reproducing apparatus having a reproducing stylus free to be vibrated substantially as described in the specification and shown in figures 6 and 7 thereof.

30. In not holding that Claim 5 of the patent in suit, No. 534543, is void as being for the function of a machine.

1612 31. In not holding that Claim of the patent in suit, No. 534543, is void as being for the function of a machine.

31. In not holding that Claim 35 of the patent in suit, No. 534543, is void as being indefinite, meaningless and claiming nothing.

33. In enjoining the manufacturing and selling of an article under Claim 5 of the patent in suit, No. 534543, which is limited to a method.

34. In granting the order for preliminary injunction.

1613 35. In not denying the motion for preliminary injunction because of complainants' failure to prove title to the patent in suit, No. 534543.

LOUIS HICKS,
Solicitor and Counsel for Defendant.

Service of a copy of within assignment of errors on this 12th day of May, 1906, is hereby admitted.

STIMSON & WILLIAMS,
Per H. P.
Solicitors for Complainants.

Filed May 10th, 1906.

1614

Citation on Appeal.

615

The President of the United States to the Victor Talking Machine Company and United States Gramophone Company, Greeting:

You and each of you are hereby cited and admonished to be and appear in the United States Circuit Court in the City, County and Southern District of New York, on the 8th day of June, 1906, pursuant to an appeal duly obtained by order of the Circuit Court of the United States for the Southern District of New York, wherein Leeds & Catlin Company is the appellant and you are the appellees, and show cause, if any there be, why the order or decree in said appeal mentioned should not be reversed, modified or corrected, and why justice should not be done in that behalf.

1616

Witness, the Honorable E. Henry Lacombe, United States Circuit Judge for the Southern District of New York, this 10th day of May, 1906.

E. HENRY LACOMBE,
United States Circuit Judge.

Service of a copy of this citation on this 12th day of May, 1906, is hereby admitted.

STIMSON & WILLIAMS,
Solicitors for Complainants.

Filed May 12th, 1906.

1617

1618

Stipulation.

CIRCUIT COURT OF THE UNITED STATES,

SOUTHERN DISTRICT OF NEW YORK.

VICTOR TALKING MACHINE COMPANY, *et al.*, Complainants, vs. TALK-O-PHONE COMPANY, Defendant.	In Equity, No. 8859. On Patent No. 534,543.
VICTOR TALKING MACHINE COMPANY, *et al.*, Complainants, vs. LEEDS & CATLIN COMPANY, Defendant.	In Equity, No. 8797, On Patent No. 534,543.

1619

For the purposes of the appeals from the orders for preliminary injunction entered May 2, 1906,
1620 in each of the above entitled suits, it is stipulated as follows:

First. That the drawings of the French Patent No. 186827, of November 8, 1887, to Emile Berliner, and the drawings of German Patent No. 45048, of November 8, 1887, to Emile Berliner are identical with the drawings of English Patent No. 15232, of November 8, 1887, to Emile Berliner, and that the drawings of said English patent may be used on appeal in connection with said French and German patents, and that the drawings of said

French and German patents need not be reproduced as part of the record on appeal in either of the above entitled suits. 1621

Second. That the drawings of Canadian Patent No. 41901, of February 11, 1893, to Werner Suess, assignor to Emile Berliner, are identical with the drawings of United States Patent No. 427279, of May 6, 1890, to Werner Suess, assignor to Emile Berliner, and that the drawings of said United States patent may be used on appeal in connection with said Canadian patent, and that the drawings of said Canadian patent need not be reproduced as part of the record on appeal in either of the above entitled suits. 1622

Third. That the patent in suit No. 534543, of February 19, 1895, from page 1, line 8, beginning with "My invention has reference to" to the signature, "Emile Berliner," on page 7, line 88, is identical with Canadian Patent No. 55079, of February 24, 1897, to Emile Berliner, except that in Claim 35 of the Canadian patent there is omitted the word, "In," which appears at the beginning of Claim 35 of the United States patent and that the drawings of the two said patents are identical and that the specification of said Canadian patents contains no other language except the introductory lines beginning "to all whom it may concern" and ending "Reference is made to the accompanying drawings in which," and except that said Canadian patent concludes, "Washington, D. C., November, 1895. Signed in the presence of," which shall be reproduced as part of the records on appeal; and that the said part of said United States patent, from page 1, line 8 to page 7, line 88 thereof, and the drawings thereof may be used on appeal in connection with said Canadian patent, and that such parts of said Canadian patent and the drawings 1623

1624 thereof need not be reproduced as part of the record on appeal in either of the above entitled suits.

Fourth. That the record catalogue of the Talk-o-Phone Company forming "Thomae Exhibit No. 8," annexed to complainants' affidavit of R. L. Thomae in the above entitled suit against the Talk-o-Phone Company need not be reproduced as part of the record on appeal in either of the above entitled suits.

Fifth. That the original texts in French of Berliner French Patents Nos. 186827, of November 8, 1887, 190602, of May 15, 1888 and 207090, of July 19, 1890, and the original texts in German of Berliner German Patents Nos. 45048, of November 8, 1887, 47099, of May 16, 1888 and 53622, of November 20, 1889, need not be reproduced as part of the record on appeal in either of the above entitled suits, and that only the translations of said texts need be reproduced on said appeals.

1625

Sixth. That in each of the above entitled suits the usual bond for costs in the sum of Two hundred and fifty dollars ($250) and a bond for Ten thousand dollars ($10,000) as security to complainants for the payment of all damages and profits due to infringement of Claims 5 and 35 of the patent in suit during the suspension, pending appeal, of said injunctions have been filed and approved, and that the said bonds need not be reproduced as part of the record on appeal in either of the above entitled suits.

1626

Seventh. That each and all of the original documents have referred to which according to this stipulation need not be reproduced as part of the record on appeal in either of the above entitled suits may be exhibited to the Court on appeal and be referred to and used on appeal in each of the

above entitled suits, should the Court on appeal so desire. 1627

Eighth. The purpose of this stipulation is to expedite the making of the record and to save unnecessary expense on appeal in each of the above entitled suits.

Dated New York, May 15, 1906.

HORACE PETTIT,
Counsel for Complainants above named.

LOUIS HICKS,
Counsel for Defendants above named.

Filed June 1, 1906. 1628

1629

1630 United States of America, }
Southern District of New York, } ss.:

I, John A. Shields, Clerk of the Circuit Court of the United States of America, for the Southern District of New York, in the Second Circuit, do hereby certify that the foregoing pages, numbered from 1 to 543 inclusive, contain a true and complete transcript of the record and proceedings had in said Court in the cause entitled Victor Talking Machine Company and United States Gramophone Company, Complainants-Appellees, against Leeds & Catlin Company, Defendant-Appellant, as the same remain of record and on file in my office.

1631 In Testimony Whereof, I have caused the seal of the said Court to be hereunto affixed, at the City of New York, in the Southern District of New York, in the Second Circuit, this 15th day of June, in the year of our Lord One Thousand Nine Hundred and Six and of the Independence of the said United States the One Hundred and Thirtieth.

JOHN A. SHIELDS,
Clerk.

[SEAL.]

[9577a]

1632

UNITED STATES CIRCUIT COURT OF APPEALS 1633

FOR THE SECOND CIRCUIT.

Nos. 166 and 167.—October Term, 1906. Argued October 12, 1906. Decided October 12, 1906.

THE VICTOR TALKING MACHINE COMPANY and THE UNITED STATES GRAMOPHONE COMPANY,
Complainants-Appellees,

vs.

THE LEEDS & CATLIN COMPANY,
Defendant-Appellant. 1634

THE SAME,
Complainants-Appellees,

vs.

THE TALK-O-PHONE COMPANY,
Defendant-Appellant. 1635

Appeals from the Circuit Court of the United States for the Southern District.

Before Judges WALLACE, LACOMBE and COXE.

Orders affirmed in open court.

LOUIS HICKS, for the Appellants.

HORACE PETTIT, for the Appellee.

1636 At a Term of the United States Circuit Court of Appeals for the Second Circuit, held in the Court Room, in the Post Office Building, in the Southern District of New York, on the 22d day of October, 1906.

Present—Hon. WM. J. WALLACE,
Hon. E. HENRY LACOMBE,
Hon. ALFRED C. COXE,
Circuit Judges.

VICTOR TALKING MACHINE COMPANY and UNITED STATES GRAMOPHONE COMPANY, Complainants-Appellees, vs. LEEDS & CATLIN COMPANY, Defendant-Appellant.	Order of Affirmance.

1637

This cause having come on to be heard upon the transcript of record on appeal from the decree for preliminary injunction of the Circuit Court of the United States for the Southern District of New York, filed and entered herein May 2, 1906, and having been argued by counsel, it is

Ordered, adjudged and decreed, that said decree
1638 be, and the same hereby is affirmed, with costs, and that a mandate issue.

E. H. L.
A. C. C.

(Endorsed)—United States Circuit Court of Appeals for the Second Circuit.—In Equity.—Victor Talking Machine Co. and United States Gramophone Co., complainants-appellees, *vs.* Leeds & Catlin Company, defendant-appellant.—Order of affirmance.—United States Circuit Court of Appeals, Second Circuit.—Filed Oct. 22, 1906.—William Parkin, Clerk.—Horace Pettit, attorney at Law, Stephen Girard Building, Philadelphia, Pa.

UNITED STATES OF AMERICA, } ss.:
Southern District of New York, } 1639

I, WILLIAM PARKIN, Clerk of the United States Circuit Court of Appeals for the Second Circuit, do hereby certify that the foregoing pages, numbered from 1 to 546, inclusive, contain a true and complete transcript of the record and proceedings had in said Court, in the case of Victor Talking Machine Company and another against Leeds & Catlin Company, as the same remain of record and on file in my office.

In testimony whereof, I have caused the seal of the said Court to be hereunto affixed, at the City of New York, in the Southern District of New York, 1640
in the Second Circuit, this 6th day of May, in the year of our Lord one thousand nine hundred and seven and of the Independence of the said United States the one hundred and thirty-first.

WM. PARKIN,
Clerk.

Seal: United States Circuit Court of Appeals, Second Circuit.

1641

UNITED STATES OF AMERICA, *ss:*

[Seal of the Supreme Court of the United States.]

The President of the United States of America to the Honorable the Judges of the United States Circuit Court of Appeals for the Second Circuit, Greeting:

Being informed that there is now pending before you a suit in which The Leeds & Catlin Company is appellant, and The Victor Talking Machine Company and The United States Gramophone Company are appellees, which suit was removed into the said Circuit Court of Appeals by virtue of an appeal from the Circuit Court of the United States for the Southern District of New York, and we, being willing for certain reasons that the said cause and the record and proceedings therein should be certified by the said Circuit Court of Appeals and removed into the Supreme Court of the United States, do hereby command you that you send without delay to the said Supreme Court, as aforesaid, the record and proceedings in said cause, so that the said Supreme Court may act thereon as of right and according to law ought to be done.

Witness the Honorable Melville W. Fuller, Chief Justice of the United States, the 28th day of May, in the year of our Lord one thousand nine hundred and seven.

JAMES H. McKENNEY,
Clerk of the Supreme Court of the United States.

[Endorsed:] 2743. File No. 20,707. Supreme Court of the United States. No. 742, October Term, 1906. Leeds & Catlin Co. *vs.* Victor Talking Machine Co., *et al.* Writ of Certiorari. United States Circuit Court of Appeals. Second Circuit. Filed May 29, 1907. William Parkin, clerk.

United States Circuit Court of Appeals for the Second Circuit.

THE VICTOR TALKING MACHINE COMPANY and THE UNITED STATES GRAMOPHONE COMPANY, Complainants-Appellees,
vs.
LEEDS & CATLIN COMPANY, Defendant-Appellant.

Stipulation.

It is hereby stipulated by and between counsel for complainants-appellees and defendant-appellant above named in the above entitled suit, which suit was removed into the said Circuit Court of Appeals by virtue of an Appeal from the Circuit Court of the United States for the Southern District of New York, that the record and proceedings in said cause heretofore certified to the Supreme Court of the United States in support of the petition for writ of certiorari herein and on file in the office of the Clerk of the Supreme Court of the

United States, shall be taken as the return to the writ of certiorari issued herein upon said petition by said Supreme Court to said United States Circuit Court of Appeals for the Second Circuit.

May 29, 1907.

HORACE PETTIT,
Counsel for Complainants-Appellees,
Victor Talking Machine Co. et al.
LOUIS HICKS,
Counsel for Defendant-Appellant,
Leeds & Catlin Company.

Endorsed: U. S. Circuit Court of Appeals for the Second Circuit. Victor Talking Machine Co. and United States Gramophone Co., Complainants-Appellees, *vs.* Leeds & Catlin Company, Defendant-appellant. (Copy) Stipulation. United States Circuit Court of Appeals, Second Circuit. Filed Jun- 15, 1907. William Parkin, clerk.

United States Circuit Court of Appeals for the Second Circuit.

The record and all proceedings whereof mention is within made, having lately been certified and filed in the office of the Clerk of the Supreme Court of the United States, a copy of the stipulation of counsel is hereto annexed and certified as the return to the writ of certiorari issued herein.

Dated New York, June 15, 1907.

[Seal United States Circuit Court of Appeals,
Second Circuit.]

WM. PARKIN,
Clerk of the United States Circuit Court
of Appeals for the Second Circuit.

[Endorsed:] 307, 20707. United States Circuit Court of Appeals, Second Circuit. Victor Talking Machine Co. & ano., Compl'ts-Appellees, *v.* Leeds & Catlin Co., Def't-Appellant. Return to Certiorari.

[Endorsed:] File No. 20,707. Supreme Court U. S. October term, 1907. Term No. 307. Leeds & Catlin Co., petitioner, *vs.* Victor Talking Machine Co. et al. Writ of Certiorari and return thereto. Filed June 17, 1907.

Supreme Court of the United States. 1

LEEDS & CATLIN COMPANY, Petitioner, vs. VICTOR TALKING MACHINE COMPANY and UNITED STATES GRAMOPHONE COMPANY, Respondents.	OCTOBER TERM, 1906.

2

And now comes the petitioner above named and upon due notice to the Victor Talking Machine Company and the United States Gramophone Company, respondents above named, prays this Honorable Supreme Court of the United States that its writ issue to the United States Circuit Court of Appeals for the Second Circuit commanding the said Court to certify to this Court its records and proceedings in the above entitled suit, to the end that the said suit and *decree for injunction* may be reviewed and determined by this Court.

Dated New York, May 4, 1907.

3

LOUIS HICKS,
Solicitor for Petitioner.

4 SUPREME COURT OF THE UNITED STATES.

LEEDS & CATLIN COMPANY, Petitioner, vs. VICTOR TALKING MACHINE COMPANY and UNITED STATES GRAMOPHONE COMPANY, Respondents.	October Term, 1906.

5 TO THE HONORABLE CHIEF JUSTICE AND ASSOCIATE JUSTICES OF THE SUPREME COURT OF THE UNITED STATES:

The petitioner above named respectfully shows:

This is a patent suit in equity involving several most important questions of the patent law of this country. The precise questions involved have never been decided by this Court and are of such importance and of such general application that the petitioner respectfully submits that the writ of *certiorari* hereby prayed for should be granted, to the end that the important, general questions of patent law presented by the record in this suit should be
6 considered and decided by this Court.

The jurisdiction of this Court, under the circumstances of this suit, to grant the writ of *certiorari*, to review the case upon the merits and to *dismiss the bill* is clear, as hereafter shown (Point Twelve, pp.), under the decision in *Harriman* v. *Northern Securities Co.*, 197 U. S., 244, 286, and cases cited.

At the time of presentation of this petition there is also presented another petition for writ of *certiorari* to review the judgment finding this petitioner in contempt for alleged violation of the

injunction decreed in this suit. The record in the 7
injunction proceedings, that is the record in this suit, is part of the record in the contempt proceedings; in other words, the record in the contempt proceedings consists of the record in this suit upon the merits and of the record of further proceedings for contempt.

In order to shorten this petition and, at the same time, to present to the Court for reference a complete argument and citation of authorities in support of the points urged in this petition, a copy of petitioner's brief in the Circuit Court of Appeals is hereto annexed. Prefixed to said brief is a short *summary and index* of the argument, from which the Court can at once fully understand the questions raised and refer to the pages of the brief where 8
the authorities are cited and discussed.

Both in the Circuit Court and in the Circuit Court of Appeals defendant contended that the case was before the Court for determination upon the merits. The failure of the Circuit Court to dismiss the bill was assigned as an error in the Circuit Court of Appeals (Assignment of Errors, No. 23, p. 537) and defendants' right to a dismissal of the bill was argued at page 198 of petitioner's brief in the Circuit Court of Appeals.

The questions presented by the record and raised by the assignment of errors (p. 534) in this suit are briefly as follows:

9

First.—WHETHER UNDER A PROPER CONSTRUCTION OF § 4887 OF THE REVISED STATUTES AS IT EXISTED WHEN THE PATENT IN SUIT WAS GRANTED ON FEBRUARY 19, 1895, A HOME PATENT EXPIRES WITH THE EXPIRATION OF THE LEGAL TERM OF A PRIOR FOREIGN PATENT GRANTED TO THE SAME INVENTOR, WHERE THE INVENTION DESCRIBED AND CLAIMED IN THE PRIOR FOREIGN PATENT IS AN INVENTION FOR WHICH THE HOME PATENT WAS GRANTED, ALTHOUGH

10 THE HOME PATENT CONTAINS CLAIMS COVERING SUBJECT MATTER NOT DESCRIBED OR CLAIMED IN THE FOREIGN PATENT IN ADDITION TO CLAIMS COVERING THE INVENTION DESCRIBED AND CLAIMED IN THE PRIOR FOREIGN PATENT.

(*This question is discussed under Points Two and Three, pp. 37, 79, of petitioner's brief in the Circuit Court of Appeals.*)

This question arises upon the evidence showing that the patent in suit No. 534,543, granted February 19, 1895, to Emile Berliner for improvements in gramophones, describes and claims in addition to
11 other matter, the invention for which German patent No. 53,622, of November 20, 1889, was previously granted to Berliner. In other words, *the invention described and claimed in the prior German patent is an invention for which the patent in suit was granted*, and the question is whether the patent in suit expired with the expiration of the legal term of the prior German patent before this suit in equity was begun under the provision of § 4887 of the Revised Statutes, which reads as follows:

> "But *every patent* granted for *an invention which has been previously patented in a foreign country* shall be so limited as to expire *at the same time with the foreign patent*, or,
12 if there be more than one, *at the same time with the one having the shortest term*, and in no case shall it be in force more than seventeen years."

The patent in suit will be found at pages 452–462 of the record, and the attention of the Court is directed especially to claims 24–34, to figures 6 and 7 and to the description of figures 6 and 7 set forth in lines 34–102 of page 5 of the patent. The German patent will be found at pages 150–154 of the record. *The invention described and claimed in the German patent and illustrated in the drawings of the Ger-*

man patent is unquestionably and concededly the same invention as that described, claimed and illustrated in the parts of the patent in suit above referred to. Moreover, the patent in suit states that while one feature of the invention has reference to improvements in the method of recording, a feature not involved in any way in this suit, the other features of the invention have reference to the construction of the details of both the recorder and reproducer of the gramophone (p. 1, lines 17-35 of the patent in suit). The German patent describes, claims and illustrates the reproducer of the gramophone, and the infringement alleged in this suit is an infringement which relates solely to a gramophone intended only for the reproduction of sound. 13

Under point two, pages 37-79, of petitioner's brief in the Circuit Court of Appeals, a copy whereof is hereto annexed, the many decisions of this Court and of the lower courts to the effect that *a home patent cannot expire in parcels, cannot be construed as running partly to one date and partly to another*, are set forth and the identity of the invention described and claimed in the German patent with the invention described and claimed in claims 24-34 of the patent in suit is fully shown. The *test* of the clear provision of the statute is, whether the invention for which the prior foreign patent was granted is an invention for which the home patent was granted. If so, the statute applies, and if the statute applies at all the home patent expires with the foreign patent. The effect of the statute cannot be avoided, under the authorities cited, by describing and claiming in the home patent something which was not described or claimed in the prior foreign patent. *It is the invention described and claimed in the prior foreign patent* which, if covered by the home patent, will cause the home patent to expire with the foreign patent. 14 15

Under Point Three, pages 79-89, of petitioner's brief in the Circuit Court of Appeals, the same question is discussed with reference to Berliner's prior French

Patent No. 207,090 of July 19, 1890, which expired July 19, 1905, before the granting of the injunction herein, but after the filing of the bill of complaint. The French patent described and claimed not only the reproducer, but also the recorder described and claimed in the patent in suit. If the decisions of the lower courts in the case at bar are permitted to stand without reversal, the patent in suit will be held *to expire in parcels*, notwithstanding the controlling decisions of this Court that such a result "*would be productive of endless confusion*," and is impossible under the statute (*Siemens' Admr.* v. *Sellers*, 123 U. S., 276, and other cases cited at pages 55–79 of petitioner's brief in the Circuit Court of Appeals).

Second.—WHETHER UNDER A PROPER CONSTRUCTION OF § 4887 OF THE REVISED STATUTES AS IT EXISTED WHEN THE PATENT IN SUIT WAS GRANTED ON FEBRUARY 19, 1895, A HOME PATENT EXPIRES WITH THE EXPIRATION OF THE LEGAL TERM OF A PRIOR FOREIGN PATENT GRANTED TO THE SAME INVENTOR WHERE THE CLAIMS RELIED UPON OF THE HOME PATENT INCLUDE ALL THE FUNDAMENTAL FEATURES OF THE PRINCIPAL INVENTION OF THE PRIOR FOREIGN PATENT, AND WHERE THE SAID CLAIMS OF THE HOME PATENT EMBODY, ACCORDING TO THE EXPRESS STATEMENT OF THE PATENTEE, A MERE MODIFICATION OF THE PRINCIPAL INVENTION OF THE PRIOR FOREIGN PATENT.

(*This question is discussed under Point Four, page 90, of petitioner's brief in the Circuit Court of Appeals.*)

In other words, the question is whether where the home patent claims *part* of the features of an invention and the prior foreign patent claims *other features* of the *same invention*, and the claims of

both the home patent and the prior foreign patent include the *main features* of the one invention, the home patent expires with the expiration of the legal term of the prior foreign patent. 19

This question arises upon the evidence showing that the claims in suit, 5 and 35, of the patent in suit cover part of the features of the invention described and claimed in three prior foreign patents to Berliner, and include the main features of that invention, being, according to the express statement of the patentee, a mere modification of the invention described and claimed in the three prior foreign patents referred to.

Claims 5 and 35 of the patent in suit, being the only claims involved, read as follows: 20

> "5. The method of reproducing sounds from a record of the same, which consists in vibrating a stylus and propelling the same along the record by and in accordance with the said record, substantially as described."
>
> "35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described."

The three prior foreign Patents to Berliner referred to are English Patent No. 15,232, of November 8, 1887, found at pages 516–527 of the record; French Patent No. 186,827, of November 8, 1887, found at pages 123–124 of the record and identical with the English patent in every respect: and German Patent No. 45,048, of November 8, 1887, found at pages 132–144 of the record. The sixteen figures of the drawing of the German patent are identical with the sixteen figures of the drawings of the French and English patents. Therefore, by stipulation (p. 540), the drawing of the English patent is to be used in connection with the French and German patents. The specification of the German 21

22 patent describes and claims the invention described and claimed in the French and English patents. A consideration, therefore, of the English patent is sufficient for a discussion and presentation of this point.

Claim 9 of the English patent reads as follows:

> "9. In a gramophone, the combination of a sound receiving diaphragm or other sonorous body; with a pivoted stylus controlled by a diaphragm, and controlling the same, and a support adapted to carry a phonautographic record sheet or a copy of such record, in solid resisting material, travelling in the plane of vibration of the point of the stylus, substantially as described."

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The English, French and German patents describe and claim the inventions and all the subject matter described and claimed in Berliner's United States patents No. 372,786, of November 8, 1887, found at page 416 of the record, and No. 564,586, of July 28, 1896, found at page 463 of the record. Patent No. 564,586 was not issued until after the patent in suit was issued, although it was applied for on November 7, 1887, nearly five years before the filing on March 30, 1892, of the application for the patent in suit. Figures 1–9 of Patent No. 564,586 are identical with figures 8–16 of the English, French and German patents, and the description and claims of

24 Patent No. 564,586 clearly describe and claim the invention which is included in the English, French and German patents and illustrated in Figures 8–16 thereof.

The seven figures of the drawing of Patent No. 372,786, are identical with Figures 1–7 of the drawings of the English, French and German patents, and the description and claims of Patent No. 372,786 describe and claim the invention included in the English, French and German patents and illustrated in Figures 1–7 of the drawings thereof.

Patent No. 564,586 shows two figures, 10 and 11, of the drawing not shown in the English, French

and German patents. Fig. 11 is unimportant and need not be considered. Berliner states in Patent No. 564,586 (p. 2, lines 22–24): 25

> "Fig. 10 is a sectional elevation of a *modified form* of my reproducing apparatus."

After describing in Patent No. 564,586 the main features of his invention, including the method of and apparatus for the recording and reproducing of sound, Berliner then refers to Fig. 10 and says (p. 4, lines 90–99):

> "Both the process and the apparatus thus far described may be modified in various ways without departing from the main features of my invention. So, for instance, I can dispense with the centering device and can rotate the record upon a stationary axis, if the diaphragm with its attached stylus is mounted in a manner to make it follow the spiral record. An arrangement of this character is shown in Fig. 10." 26

It is clear, therefore, that Fig. 10 of Patent No. 564,586 is merely a modified form of Berliner's reproducing apparatus and includes the main features of his invention. Obviously claim 8 of Patent No. 564,586 is to be read upon Fig. 10 as well as upon Fig. 1 thereof. Claim 8 of that patent, No. 564,586, is substantially identical with claim 9 of the English patent above quoted, and claim 8 reads as follows: 27

> "8. In a gramophone, the combination of a sound-receiving sonorous body; with a pivoted stylus controlled by and controlling the same, and a support adapted to carry a phonautogramic recording-service, or a copy of such record in solid resisting material, traveling in the plane of vibration of the point of the stylus; substantially as described."

The significance of the foregoing statements will now appear. In the prior suit of these complainants

against the American Graphophone Company (145 Fed., 350), the Circuit Court of Appeals disposed of the defense of more than two years' prior public use upon the ground that the invention, protected by claims 5 and 35 of the patent in suit, was illustrated in Fig. 10 of Patent No. 564,586 and described in the specification thereof. Although claims 5 and 35 of the patent in suit may protect some features of the invention not claimed in Patent No. 564,586 or in the English, French and German patents, nevertheless, claims 5 and 35 of the patent in suit are to be read upon Fig. 10, and the description of Fig. 10 contained in the specification of Patent No. 564,586. Therefore, the Circuit Court of Appeals held in the prior suit (see the opinion of that court in that suit set forth in the record in this suit at pp. 73-74) that Berliner was entitled to the date of November 7, 1887, as the date upon which he filed his application for the invention of claims 5 and 35 of the patent in suit, although the application for the patent in suit was not filed until March 30, 1892, and although the special features set forth in claims 5 and 35 of the patent in suit of the inventions described and claimed in Patent No. 564,586 were never claimed upon the application filed November 7, 1887, which resulted on July 28, 1896, in Patent No. 564,586. As the evidence contained in the record conclusively proves without contradiction that the invention of claims 5 and 35 of the patent in suit was in public use more than two years prior to the filing of the application of the patent in suit on March 30, 1892, the circumstances above stated raise a serious question hereafter to be considered under the next point as to whether or not claims 5 and 35 of the patent in suit are not invalid because of such prior public use. The point here under discussion, however, is that the Circuit Court of Appeals, both in the prior suit and this suit, was, in order to overcome the defense of prior public use, obliged to hold that the invention of claims 5 and 35 of the patent in suit was

included in the reproducing apparatus illustrated 31
in Fig. 10 and described in the specification and claimed in claim 8 of Patent No. 564,586, applied for November 7, 1887. As Berliner in that patent expressly states in accordance with the fact that the reproducing apparatus shown in Fig. 10 of that patent is a mere modification embodying all the main features of his invention described and claimed in that patent, and as claim 8 of that patent unquestionably covers the reproducing apparatus shown in said Fig. 10 as well as the reproducing apparatus shown in Fig. 1, and as the identical claims 9 of the English and French patents are substantially identical with claim 8 of Patent No. 564,-586, it follows necessarily that the invention of 32
claims 5 and 35 of the patent in suit was previously patented by the prior English, French and German patents above referred to. The decision of this Court in *Miller* v. *Eagle Mfg. Co.*, 151 U. S., 186, 198, is conclusive upon this proposition. In the Miller case this Court held upon a review of the authorities "that no patent can issue for *an invention* covered by a former patent, especially to the same patentee, *although the terms of the claims may differ;* that the second patent, although containing a *broader claim*, more generic in its character than the specific claims contained in the prior patent, is also void," and that, under the rule announced in the authorities referred to by the Court, the proposi- 33
tion "whether this invention shall be protected in *part* of its features by one patent, and as to the *rest* by another, or shall be completely protected by a single patent is a matter which concerns solely the Patent Office and the inventor" cannot be sustained. Clearly, therefore [illegible]nce Patent No. 564,586 was not issued until July [illegible]1896, subsequently to the issue on February 19, 1895, of the patent in suit, claim 8 of Patent No. 564,586 is void because the invention of that claim was previously patented by claims 5 and 35 of the patent in suit, "*although the terms of the claims may*

differ." The logical and necessary consequence is that the invention covered by claims 5 and 35 of the patent in suit was previously patented in England, France and Germany, since claims 9 of the English and French patents are identical with claim 8 of Patent No. 564,586, and the patent in suit expired with the expiration of the legal terms of the prior foreign patents. Moreover, if the decision of this Court in *Siemens' Admr.* v. *Sellers*, 123 U. S., 276, that under the statute limiting the term of a home patent by a prior foreign patent, a patent "cannot be construed as running partly from one date and partly from another. This would be productive of endless confusion," is not a correct statement of law, and it is submitted that it is a correct statement of law; and if § 4887 of the Revised Statutes is to be arbitrarily construed, in the face of the clear and imperative provisions thereof, as applying to limit the term of a home patent by the term of a prior foreign patent only when the *principal invention* of the home patent is described and claimed in the prior foreign patent, and as not applying when, in accordance with the express provision of the statute, the home patent is granted for the invention described and claimed in the prior foreign patent, or, in other words, when the invention described and claimed in the prior foreign patent is also described and claimed in the home patent, then clearly the *principal invention* embodied in claims 5 and 35 of the patent in suit was previously patented within that interpretation of the statute by the prior English, French and German patents above referred to.

It is respectfully submitted that in order to sustain the patent in suit, both the Circuit Court and Circuit Court of Appeals arbitrarily set aside the clear provision of § 4887 as to the limitation of a home patent by a prior foreign patent and the clear provision of § 4886 as to public use or sale in this country for more than two years prior to the filing of an applica-

tion for a patent, and, without any support in 37
the statutes or assigning any reason derivable from the statutes, have held that the statutes did not apply to the patent in suit, thus leaving the law upon these subjects and patents coming under the provisions of such law in a state of endless confusion.

Referring to the opinion of the Circuit Court of Appeals in the prior suit (Record, p. 74), it will be seen that that Court said:

> "The specifications in that application (for 564,586) were full enough to warrant the making of the claims here in controversy (5 and 35); at any time the application might have been amended by adding such claims, 88
> and in our opinion it is immaterial that instead of thus amending it he took the broader claims on another application filed while the first was pending. The second may fairly be considered a continuation of the first, and thus Berliner's application antedates the public use."

It is respectfully submitted that this holding of the Circuit Court of Appeals, which was necessary in order to defeat the defense of prior public use, proceeded upon the proposition that the invention of the claims in controversy (5 and 35) was the invention illustrated in Fig. 10, described in the specification and claimed in claim 8 of Patent No. 564,586. 39
Although the terms of claim 8 and of claims 5 and 35 may differ, they all protected one and the same invention, to wit, the machine shown in Fig. 10 of Patent No 564,586. Claim 8 clearly covers a machine constructed to operate as the machine shown in Fig. 10 operates, and the main features of Berliner's invention covered by claim 8 are embodied, according to Berliner's express statement, in the machine shown in Fig. 10. Claim 8 is broad enough to cover not only the modified machine shown in Fig. 10, but also the machine shown in Fig. 1; but, conceding that claim 8 and claims 5 and 35 differ as

40 to their terms and protect *different features of one and the same machine*, it is perfectly clear that all three claims protect *one and the same invention*, namely, the machine shown in Fig. 10. "*The machine is the thing patented*" (Wilson *v.* Rousseau, 4 How., 646, 683). As claims 9 of the prior English and French patents are identical with said claim 8, there is no escape from the conclusion that the invention, and the principal invention, of claims 5 and 35 was previously patented by the English, French and German patents.

Complainant's counsel, in the Circuit Court of Appeals, while admitting that the word "traveling" used in claims 1, 2, 3, 7 and 13 of Patent No.
41 564,586 referred to the travel of the surface of a tablet due to rotation only, contended that in claim 8 the word "traveling" has a different meaning and refers not to "a copy of such record in solid resisting material," but to the support 7 of Fig. 1 of Patent No. 564,586.

Referring to claim 8 of Patent No. 564,586 and to claims 9 of the English and French patents, it is clear that the combination of those claims consists of the diaphragm, which is the "sonorous body", of the stylus which is pivoted and which is controlled by and controls the diaphragm, and *either* a support adapted to carry a phonautographic record-sheet, *or*, "a copy of such
42 record in solid resisting material," traveling in the plane of vibration of the point or end of the stylus, substantially as described. The word "traveling" means "rotating" and modifies *either* "a support adapted to carry a phonautographic record-sheet," *or*, "a copy of such record in solid resisting material." In Fig. 10 of Patent No. 564,586, the word "traveling" can have no meaning other than "rotating," since the only way in which the copy of the record in solid resisting material of Fig. 10 can travel is by rotating. The contention of complainant's counsel that the word "traveling" modifies the word "support" and that the word "sup-

port" refers to the support 7 shown in Fig. 1 of the home patent No. 564,586 and in Fig. 8 of the English patent is untenable. The support mentioned in claim 8 of the home patent is "a support adapted to carry a phonautogramic recording-surface" which is the same as "a support adapted to carry a phonautographic record-sheet" in claim 9 of the English patent. That the support 7 is not a support adapted to carry a phonautogramic recording-surface, *a deposit of ink*, is clear from a reading of the specification of the English and home patents. The support 7 serves as a bearing for the bevel-gear 9 (home patent, p. 2, lines 43-44; English patent, p. 5, lines 50-51). The specifications unmistakably describe what is meant by a support adapted to carry a phonautogramic recording-surface or record-sheet. In the specifications (home patent, p. 1, lines 62-67; English patent, p. 5, lines 24-26) Berliner describes specifically what is meant by a support adapted to carry the phonautographic recording-surface. He says:

> "I have further improved the process by using a transparent plate as a *support* for the non-resisting medium. This plate is, therefore, made either of glass or some other like substance whereby I secure several important advantages."

That the non-resisting medium forms the recording-surface or record-sheet is also specifically described by Berliner (home patent, p. 1, lines 88-91; English patent, p. 5, lines 36-38) as follows:

> "In my improved process, I employ a layer of semi-fluid ink or paint, of such consistency and thickness that it will neither subside or flow spontaneously."

The support referred to in claim 8 of the home patent and in claims 9 of the English and French patents is, therefore, the support 13 shown in Fig. 1

of the home patent and Fig. 8 of the English patent, being a plate of glass or other like transparent material adapted to carry the recording medium, a layer of a semi-fluid ink or paint. The word "traveling" is used in claims 1, 4, 5, 9, 10 and 14 of the English patent and in claims 1, 2, 3, 4, 7, 8 and 13 of the home patent. Reference to these claims shows beyond all question that the support mentioned in claim 8 of the home patent and in claims 9 of the English and French patents is the traveling plate, the traveling support, the traveling plate of glass, the traveling support of glass, the rotating disc of glass, &c. In the claims referred to, as well as in the description of the patents, it is distinctly stated that a deposit of ink or like material is put upon the surface of the traveling plate, disc or support and removed therefrom by and in accordance with sound vibrations. Hence it is clear that the word "traveling" used in claim 8 of the home patent and claims 9 of the English and French patents modifies, and the punctuation shows that it modifies, either "a support adapted to carry a phonautogramic recording-surface," or, "a copy of such record in solid resisting material," and that the word "traveling" means "rotating" and that the copy of the record in solid resisting material shown in Fig. 10 can travel only by rotating.

Third.—WHETHER UNDER A PROPER CONSTRUCTION OF SECTION 4886 OF THE REVISED STATUTES AS IT EXISTED WHEN THE PATENT IN SUIT WAS GRANTED ON FEBRUARY 19, 1895, THE PUBLIC USE OR SALE IN THIS COUNTRY FOR MORE THAN TWO YEARS PRIOR TO THE APPLICATION FOR A PATENT REFERS TO THE DATE OF THE APPLICATION FOR THE PATENT IN WHICH THE INVENTION IN QUESTION IS CLAIMED AS WELL AS DESCRIBED OR TO THE DATE OF ANY AP-

PLICATION FOR A PATENT IN WHICH THE INVENTION 49
IN QUESTION IS DESCRIBED BUT NOT CLAIMED.

(*This question is discussed under Point Four, Subdivision* (e), *p. 94, of petitioner's brief in the Circuit Court of Appeals.*)

As above pointed out under Point Second, the Circuit Court of Appeals in the prior suit and in this suit overruled the defenses of public use in this country for more than two years prior to the date of the application for the patent in suit upon the ground that the subject matter of the claims, 5 and 35 in suit of the patent in suit, was described, but not claimed, in the application for 50
Patent No. 564,586, filed November 7, 1887. The application for the patent in suit was filed March 30, 1892. The defense of prior public use in the prior suit was based upon a public use before the Franklin Institute on May 16, 1888. The defense of prior public use in this suit was based upon a public use in the City of New York during the week preceding August 18, 1888, and upon the full and complete publication and disclosure of such use in the *Electrical World* for August 18, 1888, as well as upon the public use before the Franklin Institute on May 16, 1888. If, under a proper construction of § 4886, the date of the application for the patent in suit, March 30, 1892, is the date to be 51
considered, then the prior public uses referred to occurred more than two years prior to the filing of the application and the patent in suit, so far as the claims in controversy, 5 and 35, are concerned, is void. If, however, the date of the filing of the application for Patent No. 564,586, on November 7, 1887, is the date to be considered, then the prior public uses relied upon occurred subsequently to that date, November 7, 1887. In discussing this point it must be assumed, *contrary to the fact*, that the invention protected by claims 5 and 35 of the

52 patent in suit is not the invention or a feature of the invention protected by claim 8 of Patent No. 564,586 and claims 9 of the English and French patents discussed under Point Second, because, if the inventions are the same, the patent in suit and claims 5 and 35 expired with the expiration of the legal terms of the prior English, French and German patents above referred to under Point Second, and the discussion of this point in such case is unnecessary.

Referring to Judge Hazel's opinion in the prior suit, it will be seen that Judge Hazel, dealing with the claims 5 and 35 in controversy, and with the subject matter of the patent in suit and of the ap-
53 plication for Patent No. 564,586, said (Record, p. 71):

> "As already appears, the patent in suit was issued upon a later application than Patent No. 564,586. Why the broad claims of the former were not made a part of the earlier application and specification does not appear."

The Circuit Court of Appeals, affirming Judge Hazel's decree in the prior suit, overruled the defense of prior public use made in the prior suit, not upon the ground relied upon by Judge Hazel that the public use was experimental, but upon the ground stated in the opinion of the Circuit Court of Appeals,
54 as follows (Record, p. 74):

> "The specifications in that application (for 564,586) were full enough to warrant the making of the claims here in controversy; at any time the application might have been amended by adding such claims, and in our opinion it is immaterial that instead of thus amending it, he took the broader claims on another application filed while the first was pending."

The application for the patent in suit was not filed as a division of the application filed November 7, 1887 (see patent in suit, p. 472). It also appears

from the findings of Judge Hazel and the Circuit 55
Court of Appeals in the prior suit, in evidence in this suit (Record, pp. 71 and 74), that the claims here in controversy were never made upon the prior application. Such findings were in accordance with the file-wrappers and contents of the patent in suit and of Patent No. 564,586 (see record on appeal in prior suit, pp. 157, 275; 145 Fed., 350). It is the fact, and there was no evidence in the prior suit or in this suit to the contrary, that the special features of the claims here in controversy, 5 and 35, as construed by the Circuit Court of Appeals, were first made the basis of an application for a patent and claimed in the application for the patent in suit, filed March 30, 1892.

Upon the question of proof of public use, it is not 56
necessary to do more than to refer the Court to the article in the *Electrical World* for August 18, 1888 (Record, p. 274), and to the affidavits of Martin and Wetzler (Record, pp. 191, 194), to show that the invention of claims 5 and 35 was publicly used in the City of New York during the week preceding August 18, 1888, and fully described in the *Electrical World* for that date, together with a perfect illustration and description of the machine operating according to the invention of those claims. Moreover, the public use before the Franklin Institute, relied upon in the prior suit, is shown by the testimony of Mr. Berliner (Record, pp. 230–242, especially 57
Q. 13 and Q. 14, p. 232), by Berliner's lecture delivered before the Franklin Institute on May 16, 1888 (Record, pp. 245–273, especially pp. 268–270 and illustration on p. 269 of reproducing apparatus, May, 1888) and by the article in the *Electrical World* for November 12, 1887 (Record, pp. 243–244, especially the last two paragraphs of first column on p. 244, and first two paragraphs of second column on p. 244).

If the public use before the Franklin Institute was experimental, and the Circuit Court of Appeals refused to hold that it was, the public use in the

City of New York during the week preceding August 18, 1888 was unquestionably a public use within the meaning of § 4886. Since this public use occurred more than two years prior to the filing of the application by Berliner for the patent in suit and more than two years before Berliner filed any application claiming the subject matter of the claims here in controversy, 5 and 35, assuming that the subject matter of claims 5 and 35 is not the invention of claim 8 of Patent No. 564, 586 and of claims 9 of the English and French patents above mentioned, it is respectfully submitted that the defense of a public use in this country more than two years prior to the filing of the application by Berliner for a patent for the invention of claims 5 and 35 is conclusively established within the meaning of § 4886 of the Revised Statutes. Of course, in the Circuit Court and in the Circuit Court of Appeals this petitioner was precluded by the prior decision of the Circuit Court of Appeals from arguing this point, but it was specifically set forth in the assignment of errors (see errors assigned, Nos. 24 and 25, Record, p. 537) in order that the question might be raised and passed upon by this Court.

As will be seen from an examination of the authorities collated and cited by the Circuit Court of Appeals in *Hayes-Young Co.* v. *St. Louis Co.*, 137 Fed., 80, 82, 83, and *Western Elec. Co.* v. *Sperry Co.*, 58 Fed., 186, 191, 192, in cases where a second application has been held to be a continuation of a first application and to relate back to the date of the first application, it has appeared (1) that the invention described and claimed in the second application was claimed as well as described in the first application; (2) that special circumstances existed connecting the second application with the first application and showing that the second application was in fact, and was intended to be, a continuation of the first application, and (3) that between the filing of the first application and the filing of the second application the applicant had not abandoned

the invention described and claimed in the second application or done anything estopping him from making claim thereto. In the case at bar, however, it appears (1) that Berliner, in his application filed November 7, 1887, for Patent No. 564,586, described the subject matter of claims 5 and 35 of the patent in suit, according to the construction of these claims heretofore made by the courts, as a mere modification, retaining the main features of the invention described and claimed in Patent No. 564,586, but made no claim therefor; (2) that *between* the filing of the first application for Patent No. 564,586 on November 7, 1887, and the filing of the second application for the patent in suit on March 30, 1892, Berliner, as appears from the following Fourth Point of this petition and from Point Six, page 115, of petitioner's brief in the Circuit Court of Appeals, as the assignee of Werner Suess, asserted under oath, in an application filed May 5, 1891, for Letters Patent of Canada, that the invention held by the Circuit Court and the Circuit Court of Appeals to be the invention covered by claims 5 and 35 of the patent in suit, and illustrated by Fig. 10 of Patent No. 564,586, was the sole invention of Werner Suess; and (3) that no circumstance appears connecting the second application for the patent in suit with the first application for No. 564,586, or showing that the second application was in any sense whatever a continuation of the first application. *Two years' prior public use and abandonment are clear* (*Western Elec. Co.* v. *Sperry Co.*, 58 Fed., 186, 191, 192). Fig. 3 of the patent in suit is a machine of entirely different construction from Fig. 10 of Patent No. 564,586, and shows as a part thereof the reproducer illustrated in Figs. 6 and 7, which Berliner, in the patent in suit (p. 1, lines 23–37), stated is one of the essential features of the invention of the patent in suit. Excepting the reproducer, the machine shown in Fig. 3 of the patent in suit is the gramophone, which, in the Canadian patent, Berliner described

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64 and claimed broadly as the invention of Suess. The inventions described and claimed in the first application are essentially different from the inventions described and claimed in the second application for the patent in suit, as a comparison of the two patents will show. Claims 5 and 35 of the patent in suit when properly construed, as pointed out under points seven and twelve (pp. 130, 187) of petitioner's brief in the Circuit Court of Appeals, are limited by Berliner's improvements in the details of construction of his reproducer illustrated in Figs. 6 and 7 of the patent in suit; if, however, Judges Hazel and Townsend and the Circuit Court of Appeals were right in holding that the invention of
65 claims 5 and 35 of the patent in suit is the invention illustrated in Fig. 10 and described at page 4, lines 90–117 of Patent No. 564,586, in such case it necessarily follows that the invention of claims 5 and 35 of the patent in suit is a mere modification of the principal invention described in claim 8 of Patent No. 564,586 and in claims 9 of the prior English and French patents of November 8, 1887, above considered under Point Two of this petition and under Point Four (p. 90) of petitioner's brief in the Circuit Court of Appeals, and that claims 5 and 35 expired on November 8, 1901, with the expiration of the English patent, and on November 8, 1902, with the expiration of the French patent, long prior to the
66 commencement of this suit in 1904. *The point here, however, is that two years prior, public use and abandonment are clearly proven.*

Fourth.—WHETHER WHERE A PERSON, AS THE ASSIGNEE OF ANOTHER, FIRST APPLIES IN A FOREIGN COUNTRY FOR A PATENT FOR AN INVENTION, AND UPON SUCH APPLICATION SECURES IN THE FOREIGN COUNTRY A PATENT BROADLY DESCRIBING AND CLAIMING THE INVENTION, AS THE INVENTION OF ANOTHER, SUCH PERSON CAN, AFTER THE FILING OF SUCH APPLICATION IN

THE FOREIGN COUNTRY, FILE AN APPLICATION AND 67
SECURE A PATENT IN THIS COUNTRY FOR THE SAME INVENTION AS HIS OWN INVENTION. IN OTHER WORDS, UNDER SUCH CIRCUMSTANCES, CAN THE CLAIMS OF THE HOME PATENT BE CONSTRUED TO COVER THE INVENTION DESCRIBED AND CLAIMED IN THE PRIOR FOREIGN PATENT.

(*This question is discussed under Point Six, p. 115, of petitioner's brief in the Circuit Court of Appeals.*)

This question arises upon the evidence showing that on May 5, 1891, Berliner, as the assignee 68
of Werner Suess, filed an application in Canada upon which, on February 11, 1893, Letters Patent of Canada, No. 41,901, were granted (Record, p. 169, fol. 507). The Canadian patent is set forth in the record at pages 155–168. By stipulation (Record, p. 541) the drawings of the Canadian patent are identical with the drawings of U. S. Patent No. 427,279, of May 6, 1890, to Berliner as the assignee of said Suess, which latter patent is to be found in the record at page 446. The file wrapper and contents, including the assignment, petition, powers of attorney and proceedings in the Patent Office of the Canadian patent, are to be found in the record at pages 169–175. The petition (Record, p. 170) was 69
signed by Berliner, who asserted therein that Werner Suess had "invented new and useful improvements in gramophones, not known or used by others before his invention thereof," and that Berliner, by an assignment, "acquired the right of obtaining a patent from Werner Suess aforesaid for the said invention," and "prays that a patent may be granted to him as the assignee of the said Werner Suess for the said invention."

That the Canadian patent describes and broadly claims the invention covered by the claims, 5 and 35, of the patent in suit, here in controversy is fully

70 shown in petitioner's brief (Point Six, pp. 115–130) in the Circuit Court of Appeals, a copy whereof is hereto annexed. Referring to the opinion of Judge Townsend, it appears that Judge Townsend found that the Canadian patent "discloses and broadly claims the invention covered by the claims here in suit" (Record, p. 324, fol. 971) and that "the Canadian patent in terms describes and claims the broad, generic invention of Berliner covered by the claims here in suit" (Record, p. 325, fol. 973). With this finding of Judge Townsend the Circuit Court of Appeals agreed, as will be seen from the oral statement of that court made when affirming upon the argument Judge Townsend's decree. The Circuit Court
71 of Appeals said:

> "Of course, if the Canadian patent expired the United States patent expired at the same time."

(See *infra*, Point Thirteen, p. of this petition.) In view of this Canadian patent which was not in evidence in the prior suit, this petitioner contends that the construction given to the claims 5 and 35 in the prior suit was incorrect, not warranted by the specification of the patent in suit, and unreasonable by reason of the fact that in the Canadian patent Berliner, as the assignee of Suess, had previously described and claimed the broad invention which in
72 the prior suit, in the absence of the Canadian patent, the courts had construed the claims 5 and 33, in controversy, to cover. As this question is of such great importance, and as it has been fully treated under Point Six (pp. 115–130) of petitioner's brief in the Circuit Court of Appeals hereto annexed, and as both the Circuit Court and the Circuit Court of Appeals have squarely held that the Canadian patent describes and broadly claims the invention of the claims 5 and 35, here in suit, as construed by the courts in the prior suit and in this suit, but little needs to be said further in this petition. It is desired only to point out that in *Matheson* v. *Campbell*,

78 Fed., 910, 917, the Circuit Court of Appeals for the 73
Second Circuit said:

> "It must be *sound law*, as it is reasonable *common sense* to hold that the *tests of prime importance* in a suit for infringement are those which the *patent itself* prescribes. The inventor certainly may be assumed to know what it is that he has invented. If any one is able to describe the product of his inventive skill, it is himself. He surely knows the earmarks of the thing he seeks to patent. * * *"

Referring to the patent in suit, it will be seen that Berliner describes all the features of his invention at page 1, lines 17-36 thereof, as follows:

> "*One feature* of my invention has reference to *improvements* in the *method of recording sound* by tracing upon a fatty film deposited upon a metallic surface, undulatory lines, corresponding to sound waves, and then etching such lines in the metal base, or, as it is now commonly called, the record tablet; while the *other features* of my invention have reference to the *construction of the details of both the recorder and the reproducer of the gramophone.* Each of these *features of improvement* are designed to overcome certain difficulties, and to avoid certain imperfections *heretofore met with in the operation of the gramophone.* These difficulties and imperfections, and the manner in which they are avoided, will be particularly pointed out in the following description with reference to the accompanying drawings, in which——" 74 75

This is the patentee's express declaration of the features of improvements contained in the patent, and no other declaration whatever of any other feature of improvements is to be found elsewhere in the patent. In the face of this express and positive declaration of the patentee as to what are the features of his invention, the Circuit Court and the Circuit Court of Appeals have held not only that the patent included other features not enumerated

76 by Berliner, but have gone even further and held that the features which Berliner did enumerate as the features of his invention are not the principal features of his invention, but are mere minor details; and finally the Circuit Court and the Circuit Court of Appeals reached the unreasonable and the untenable conclusion that the claims, 5 and 35, here in controversy, were not to be limited in any way by the features which Berliner in the specification pointed out as the principal features of his invention, but were to be broadly construed so as to cover the invention which Berliner had previously broadly described and claimed in the Canadian patent as the invention of Suess.

77 It is, therefore, respectfully submitted that the broad construction given to claims 5 and 35 in the prior suit and in this suit is a construction which renders claims 5 and 35 invalid, because anticipated by Suess in the Canadian patent; that such broad construction of claims 5 and 35 is, upon the facts stated, unreasonable and untenable; and that claims 5 and 35, when properly and reasonably construed in view of the Canadian patent and of the express statement of Berliner in the patent in suit as to the features of his invention, must be limited, as argued under Point Six of petitioner's brief in the Circuit Court of Appeals, by Berliner's improvements in the details of construction of his reproducer.

78 In his lecture before the Franklin Institute Berliner said (Record, p. 266):

> "I will now describe the *most important* apparatus of the *gramophone*—the *recorder*."

Equally important with the recorder is, of course, the reproducer, which, as Berliner stated in the Franklin Institute lecture (Record, p. 268),

> "is constructed on precisely the same principles as the recorder."

The recorder and the reproducer are not minor details, therefore, of the invention of the patent in

suit, but constitute, as Berliner says, the principal features of the invention of the patent in suit. A proper construction of claims 5 and 35 must include the features of construction of the reproducer, whereby the reproducer is permitted to vibrate laterally in the manner described in the specification of the patent. As pointed out under Point Six, subdivision (*i*), at page 127 of petitioner's brief in the Circuit Court of Appeals, petitioner used the reproducer of the Suess gramophone of the Canadian patent, which reproducer has none of the features of the invention of the patent in suit. Petitioner's machines embody the invention of Suess, only, and unless claims 5 and 35 can be construed so as to cover broadly the invention of the Canadian patent, they cannot be construed so as to cover petitioner's machines. 79 80

As this defense was not met by the opinion of Judge Townsend in the Circuit Court, as it was not met by the oral statement in the Circuit Court of Appeals, and as it is clearly conclusive in reason, this Court is respectfully requested carefully to consider the argument made in support thereof under Point Six of petitioner's brief in the Circuit Court of Appeals hereto annexed, and to pass upon the question whether it is possible to hold that claims 5 and 35 can reasonably and properly be construed so as to cover an invention which the patentee, Berliner, had previously asserted in the most solemn and irrevocable manner in the Canadian patent, was the invention of Suess; and, if it is possible so to hold, whether claims 5 and 35 are not invalid, because before filing his application for the patent in suit Berliner asserted in the Canadian patent that the invention thereof was the invention of Suess, and thereby became estopped from thereafter claiming the invention as his own. 81

82 **Fifth.**—WHETHER, BY ELECTING TO CLAIM IN A FOREIGN COUNTRY AN INVENTION AS THE INVENTION OF ANOTHER UPON AN APPLICATION RESULTING IN A PATENT, THE APPLICANT FOR SUCH FOREIGN PATENT DOES NOT ABANDON ANY RIGHT WHICH HE, HIMSELF, MAY HAVE HAD SUBSEQUENTLY TO CLAIM THE SAME INVENTION AS HIS OWN IN THIS COUNTRY AND DOES NOT BECOME ESTOPPED FROM SO DOING.

(*This question is discussed under Point Seven, page 130, of petitioner's brief in the Circuit Court of Appeals.*)

83 This question arises upon the evidence showing that on May 5, 1891, Berliner, as the assignee of Werner Suess, filed an application in Canada upon which, on February 11, 1893, Letters Patent of Canada No. 41,901, were granted (Record, p. 169, fol. 507). The application for the patent in suit was not filed until March 30, 1892. Judge Townsend and the Circuit Court of Appeals held that the invention of claims 5 and 35 of the patent in suit, as construed by them, was the invention described and broadly claimed by Berliner in the Canadian patent as the invention of Suess. The facts relating to this point are fully set forth under Points Seven, Twelve and Six (pp. 130,
84 187, 115) of petitioner's brief in the Circuit Court of Appeals. Assuming that claims 5 and 35 of the patent in suit are not to be limited by Berliner's improvements in the details of construction of his reproducer, and that when correctly construed they cover the invention described and broadly claimed by Berliner in the Canadian patent as the invention of Suess, it is clear that Berliner irrevocably abandoned all claim to the invention when he filed the application for the Canadian patent as the assignee of Suess, nearly a year before he filed the application for the patent in suit, and that when he filed the ap-

plication for the patent in suit, he was estopped from 85
claiming as his own the invention, which, in the Canadian application, he alleged under oath to be the invention of Suess. Neither Judge Townsend nor the Circuit Court of Appeals has shown how claims 5 and 35 of the patent in suit can, under the facts disclosed, be construed to cover the identical invention described and broadly claimed by Berliner in the Canadian patent as the invention of Suess; nevertheless, they have so construed the claims. Neither Judge Townsend nor the Circuit Court of Appeals has explained how, under the circumstances, abandonment of the invention by Berliner and estoppel are not clearly made out. It is respectfully submitted that the evidence of the Canadian patent 86
conclusively shows (1) that the construction given to claims 5 and 35 of the patent in suit is incorrect, and that the finding of infringement by defendant is incorrect as a consequence; and (2) that if the construction given to the claims be correct abandonment of the invention and estoppel are clearly proved.

Sixth.—WHETHER A HOME PATENT EXPIRES WITH THE EXPIRATION OF THE SIX YEAR TERM OF A PRIOR CANADIAN PATENT FOR THE SAME INVENTION, WHERE THE RIGHT TO PROLONG THE TERM OF THE CANADIAN PATENT FOR A FURTHER TERM OR TERMS BY THE PAY- 87
MENT OF A FURTHER FEE OR FEES HAS NOT BEEN EXERCISED, AND THE CANADIAN PATENT HAS BEEN PERMITTED TO EXPIRE AT THE EXPIRATION OF THE SIX YEAR TERM.

(*This question is discussed under Point Eight, page 145, of petitioner's brief in the Circuit Court of Appeals.*)

This important question of law arises upon the evidence showing that the Canadian Patent

88 No. 41,901 of February 11, 1893, was granted to Berliner as the assignee of Suess, prior to the granting of the patent in suit on February 19, 1895, and upon the holding of Judge Townsend and the Circuit Court of Appeals, that the invention of claims 5 and 35 of the patent in suit is described and broadly claimed in the Canadian patent. The authorities in support of the proposition that the patent in suit expired with the expiration of the six year term of the Canadian patent on February 19, 1895, long before this suit was begun, are collated and discussed under Point Eight of petitioner's brief in the Circuit Court of Appeals. It is respectfully submitted that the decision of
89 this court in *Commercial Mfg Co.* v. *Fairbank Co.*, 135 U. S., 156, considered at pages 164 and 59 of petitioner's brief in the Circuit Court of Appeals, is conclusive in support of the proposition. It is also respectfully submitted that the clear meaning and purpose of the statute was that a home patent should expire with a prior foreign patent in every case where the prior foreign patent expires by lapse of time and does not lapse or become forfeited through the breach of a condition subsequent, such as the non-payment of taxes or failure to work the patent and the like.

90 **Seventh.**—WHETHER THE PATENT IN SUIT WAS NOT ANTICIPATED BY ENGLISH PATENT NO. 1644 OF 1878, TO EDISON, AS TO CLAIMS 5 AND 35, IF THOSE CLAIMS ARE TO BE BROADLY CONSTRUED AND NOT LIMITED BY THE SPECIAL FORM OF REPRODUCER SHOWN IN FIGURES 6 AND 7.

(*This question is discussed under Point Ten, page 176, of petitioner's brief in the Circuit Court of Appeals.*)

This valid defense was not even considered by Judge Townsend or by the Circuit Court of Appeals

in the case at bar, because the Edison English Pat- 91
eut No. 1644 of 1878 was contained in the record of the prior suit. It was used, however, for a specific purpose in the prior suit, and the defense raised in this suit was in no way presented to the Court in the prior suit or considered or passed upon by the Court in the prior suit. Under the decision of this Court in *Mast, Foos Co.* v. *Stover Mfg. Co.*, 177 U. S., 485, the defense based upon that patent in this suit should have been considered and decided according to its merits.

Eighth.– WHETHER THE PATENT IN SUIT WAS NOT ANTICIPATED BY PATENT NO. 341,214, OF MAY 4, 92
1886, TO BELL & TAINTER.

This defense was one of the defenses chiefly relied upon in the prior suit of these complainants against the American Graphophone Company, as appears from Judge Hazel's opinion set forth in the record in this suit (p. 63). The Bell & Tainter patent is to be found at page 387 of the record, and the corresponding English patent is to be found at page 488 of the record. Assignment of Errors Nos. 10, 26 and 27 (Record, p. 534) raise the question here presented, which, of course, was not open to petitioner in the Circuit Court of Appeals and *never* will be open to petitioner unless the writ 93
of *certiorari* hereby prayed for is granted.

As appears from claims 5 and 35 of the patent in suit, the invention in controversy consists of a stylus "free to be vibrated and propelled" by the record. This freedom of the stylus is the result of the loose mounting of the reproducer arm, and its practical embodiment is, and has always been, in the employment of a universal joint for connecting the reproducer arm with its support.

94 Bell & Tainter describe this construction as the fourth part of their invention, saying, in U. S. Patent No. 341,214 (p. 391, line 84),

> "The invention consists fourthly, in loosely mounting the reproducing-style so that it can readily be guided by the record."

In the corresponding English Patent No. 6027, of 1886, Bell & Tainter make the same statement and add (p. 489, line 24),

> "This may be accomplished in different ways as, for example, by mounting the head of the reproducing instrument upon a *joint* which admits of a *lateral* movement."

95 In U. S. Patent No. 341,214, it is said, immediately after the part above quoted (p. 391, line 86),

> "Preferably the reproducing-style, or rather what may be called the 'head' of the reproducing instrument, is mounted on an *universal joint*, and the style is pressed against the record by the yielding pressure of a spring or weight."

Both the United States patent (p. 392, line 1) and the English patent (p. 489, line 50) state that the reproducing style mounted as just explained may be usefully employed in connection with records of various forms. Disc records are described in both patents and the vertical and lateral undulations of
96 the record groove was described by Edison at the time of the invention of all sound recording and reproducing instruments in English Patent No. 1644 of 1878 (p. 473, line 53), and in U. S. Patent No. 200,521, of February 19, 1878 (p. 336, top second column). The claims, 5 and 35, of the patent in suit are for a stylus free to be propelled (laterally, of course), by the record, and claims 19 of the Bell & Tainter United States and English patents read as follows:

> "19. The combination with the reproducing style of a mounting therefor, which

> leaves said style *free to move laterally* and thereby adjust itself automatically to a sound record, substantially as described." 97

Clearly Bell & Tainter describe the precise mounting of the reproducing stylus described in the claims 5 and 35 of the patent in suit. In each case the stylus is both vibrated and moved laterally by the record-groove. The use of a swinging arm, mounted on a universal joint, which permits the record-groove to move the stylus all the way across the face of the record was, according to the express statement of Berliner, the invention of Werner Suess. Berliner not only stated under oath in Canadian Patent No. 41,901, of February 11, 1893, that 98

> "11. In an apparatus for reproducing sounds from a rotating record-tablet, a reproducing stylus mounted to have a free movement over the surface of the record-tablet. substantially as described,"

was the invention of Suess (Record, p. 167); but Berliner, in his lecture before the Franklin Institute on May 16, 1888, also said that Suess (p. 270)

> " suggested to mount the sounder on a pivot at some distance from the disc and then let the reproducing-groove guide the sounder across the disc over an arc of flat amplitude. This happy idea is embodied in the present apparatus, and is a very ingenious adaptation indeed." 99

It is very clear that the *swinging arm* shown in Fig. 3 of the patent in suit and described in the specification thereof, if not the invention of Edison (English Patent No. 1644 of 1878, p. 479, lines 48–53), was the invention of Suess. The mounting of the reproducing stylus so that it is free to be vibrated and propelled by the record-groove was clearly disclosed by Bell & Tainter. Claims 5 and 35 of the patent in suit are not limited by a swinging arm capable of permitting the record-groove to move the stylus entirely across the face of the record, and

100 there is no suggestion in the claims that the vibrating and propelling of the stylus is to be accomplished without the aid of a feed-screw. The claims are for a stylus free to be vibrated and propelled by the record groove, and such stylus was clearly described in the prior United States and English patents to Bell & Tainter. Even before Suess, Edison, as above stated, in English Patent No. 1644 of 1878, disclosed in Fig. 34 and described at page 8, line 48, a stylus carried at the end of a swinging-arm and free to be vibrated and propelled by the record-groove. This was claimed by Edison in claim 1 of the patent, which reads as follows (p. 482):

101 "FIRST.—The combination with the diaphragm and point of a flat receiving surface and means for revolving the receiving surface, and *causing the point to follow a volute or spiral line*, substantially as represented in Figs. 1, 2, 6, 7, 8, 9, 10 and 34."

Thus Edison distinctly pointed out and claimed, as *equivalents*, the causing of the stylus to follow the record groove, either by propelling the stylus across the face of the record by the walls of the record groove *alone* and without mechanical assistance, *as in Fig. 34*, or by similarly propelling the stylus with the assistance of a feed-screw, as in Figs. 1 and 2, for example.

102

Ninth.—WHETHER CLAIMS 5 AND 35 OF PATENT IN SUIT ARE NOT INVALID AS BEING CLAIMS FOR THE FUNCTION OF A MACHINE.

This question was raised by Assignment of Errors, Nos. 30 and 31 (Record, p. 534). Claims 5 and 35 of the patent in suit read as follows:

"5. The method of reproducing sounds from a record of the same which consists in vibrating a stylus and propelling the same

along the record by and in accordance with 103
the said record, substantially as described.

"35. In a sound reproducing apparatus consisting of a traveling tablet having a sound record formed thereon and a reproducing stylus shaped for engagement with said record and *free to be vibrated and propelled* by the same, substantially as described."

Judge Wallace stated, at the opening of his opinion, in the Circuit Court of Appeals, in the contempt proceedings in this suit, to review which contempt proceedings a petition for writ of *certiorari* is presented herewith, that claim 5 "covers merely the function of the machine" and that "it is more than doubtful whether the claim is not void upon 104
its face" (see record certified in support of petition for writ of *certiorari* to review contempt proceedings).

The decision of this Court in *Westinghouse* v. *Boyden Co.*, 170 U. S., 537, 554, and 70 Fed., 816, 829, is sufficient authority to show that claims 5 and 35 are invalid as being for the function of a machine. In that case it was held that if, in a claim for a combination of mechanical elements, *one* of the elements be properly interpreted as a function, the entire claim would be void, since it would be open to the objection, held in several cases to be fatal, that the mere function of a machine cannot be patented. Clearly claim 5 describes nothing but 105
the function of the machine illustrated in Fig. 3. Claim 35 includes as an element a stylus "free to be vibrated and propelled" by the record. This function is clearly the function of the stylus shown in Fig 3 of the patent in suit. Claim 35 cannot be limited and held valid by construing the stylus "free to be vibrated and propelled" as meaning a stylus mounted upon a swinging arm, such as the swinging arm shown in Fig. 3, because, as Berliner

stated in his lecture before the Franklin Institute
106 (p. 270, fol. 809) and in the Canadian patent (p. 155), the swinging arm was the invention of Suess.

Tenth.—WHETHER CLAIM 35 OF THE PATENT IN SUIT IS NOT VOID AS BEING INDEFINITE, MEANINGLESS AND CLAIMING NOTHING.

This question is raised by Assignment of Error No. 31 (p. 534). Claim 35 reads as follows:

> "35. *In a sound reproducing apparatus* consisting of a travelling tablet having a sound record formed thereon and a repro-
107 ducing stylus shaped for engagement with said record and free to be vibrated and propelled by the same, substantially as described."

All that claim 35 does is to describe a sound reproducing apparatus in which *something not stated* is to be claimed. Under the decision of this Court in *Merrill* v. *Yeomans*, 94 U. S., 568, 573:

> "The public should not be deprived of rights supposed to belong to it without being clearly told what *it is* that limits these rights."

108 In Merrill's case the patentee had claimed a process only, and had brought suit alleging that the sale of a product infringed the patent. The Court held that the sale of a product could not infringe a claim for a process and that the patentee's remedy was "by a surrender and re-issue. When this is done, the world will have fair notice of what he claims." Clearly claim 35 claims nothing.

Eleventh.—WHETHER CLAIMS 5 AND 35 OF THE PATENT IN SUIT, WHEN CONSTRUED WITH REFERENCE TO THE CANADIAN PATENT TAKEN OUT BY BERLINER AS THE ASSIGNEE OF SUESS, AND WITH REFERENCE TO EDISON'S ENGLISH PATENT NO. 1644, OF 1878, ARE INFRINGED BY DEFENDANT'S MACHINES. 109

(*This question is discussed under Point Twelve, page 187 of petitioner's brief in the Circuit Court of Appeals.*)

The question presented by this point involves the general question above discussed under Point Four of this petition, whether claims 5 and 35 of the patent in suit can reasonably be construed to cover an invention which Berliner, before he applied for the patent in suit, asserted under oath, upon the application for the Canadian patent, was broadly the invention of Suess. 110

Twelfth.—THE FOREGOING DEFENSES RAISE PURE QUESTIONS OF LAW AND PRESENT THE WHOLE CASE TO THE COURT FOR FINAL DISPOSITION UPON THE MERITS. THIS COURT HAS HELD IN HARRIMAN V. NORTHERN SECURITIES CO., 197 U. S., 284, 286, THAT UNDER SUCH CIRCUMSTANCES, IN A PROPER CASE, A PETITION FOR CERTIORARI SHOULD BE GRANTED. 111

Although the decree in this suit is an interlocutory decree granting an injunction *pendente lite*, nevertheless, it is clear that the questions presented are pure questions of law and that the entire case is before the Court in such manner that the Court can and should dispose of the case finally upon the merits. It would take years of time and cost thousands of dollars to go back to the Circuit Court, again present the same evidence, go through the idle ceremony and great expense of printing the

112 record and presenting it to a Court already bound by the decision heretofore rendered, carry the case on appeal to the Circuit Court of Appeals, which has already finally disposed of the questions involved and practically of the entire case upon the merits, and then again to present a petition for a writ of *certiorari* to this Court.

During the pendency of this suit another suit brought by the same complainants, upon the same patent and in the same Court, against another defendant, the American Graphophone Company, was brought to final hearing and a decree sustaining the patent, finding infringement and granting an injunction, with reference to claims 5 and 35 of the
113 patent, was entered October 27, 1905. In the said suit against the American Graphophone Company, which was decided by Judge Hazel in the Circuit Court (140 Fed.. 860), the injunction was likewise stayed pending appeal because of the difficulty and importance of the questions involved, and on appeal the United States Circuit Court of Appeals for the Second Circuit affirmed Judge Hazel's decree in March, 1906 (145 Fed., 350).

Judge Hazel's opinion is set forth at pages 63-73 of the record in this suit. The opinion of the Circuit Court of Appeals affirming Judge Hazel's decree is set forth at pages 73-74 of the record in this suit. Judge Townsend's opinion in the Circuit Court
114 in this suit is set forth at pages 318-327 of the record in this suit. In affirming Judge Townsend's decree in the Circuit Court in this suit, the Circuit Court of Appeals gave no written opinion, but the oral statements of the Court in affirming the decree are hereinafter set forth in this petition (pp. 41-46).

It thus appears that in this suit in equity, when complainants moved in the Circuit Court for an injunction against defendant, the patent in suit had been sustained, as to the claims five and thirty-five here involved, by Judge Hazel in the suit against the American Graphophone Company, and Judge Hazel's decree had been affirmed by the Circuit

Court of Appeals. Under familiar practice defend- 115
ant, the petitioner above-named, was not free to argue again, either in the Circuit Court or in the Circuit Court of Appeals, any of the grave and important questions of law decided in the prior suit. However, new defenses of the first importance were raised in this suit and by a record which presented the whole case to the Circuit Court in such wise that the Circuit Court and the Circuit Court of Appeals might properly have finally disposed of the suit by decree, in accordance with the well settled rule upon that subject. Although the decree for injunction in this suit was an interlocutory decree made upon a motion for an injunction *pendente lite*, an examination of the record 116
discloses that the record presented the whole case to the Court, and it is clear that, in view of the decisions of the Circuit Court and of the Circuit Court of Appeals in the prior suit and in this suit, the Circuit Court of Appeals has practically finally disposed of the case in favor of the complainants. No useful purpose would be served by compelling the petitioner, at great expense, to raise again in the Circuit Court and again in the Circuit Court of Appeals the very questions which each of those Courts has already twice passed upon. Moreover, in this suit in equity the record presented the entire case to the Circuit Court and to the Circuit Court of Appeals, and under numerous 117
decisions of this Court both the Circuit Court and the Circuit Court of Appeals could and should have finally disposed of the case in favor of the defendant, the petitioner above named, and could and should have dismissed the bill. The only claims of the patent involved, either in this suit or in the prior suit, are claims 5 and 35, complainants having abandoned not only in the prior suit, but also in this suit any contention that claim 32 or any claim other than claims 5 and 35 are infringed.

It is not necessary to enter into any discussion as to the jurisdiction of this Court in the premises,

118 since in the very recent case of *Harriman* v. *Northern Securities Co.*, 197 U. S., 244, 286, this Court granted a writ of *certiorari* under similar circumstances, entertained jurisdiction, affirmed the order of the Circuit Court of Appeals reversing the order of the Circuit Court for a preliminary injunction and did what the Circuit Court of Appeals might have done but did not do, namely, dismissed the bill. Although in the Harriman case the Circuit Court of Appeals merely reversed the order of the Circuit Court granting the preliminary injunction and refused to dismiss the bill, the complainants insisted that the Circuit Court of Appeals had practically disposed of the entire controversy on the merits. This
119 Court accepted that view and granted the writ under the circumstances, notwithstanding the fact that the decree was not final. In the opinion of this Court "the record presented the whole case to that Court in such wise that it might properly have been finally disposed of in terms by its decree in accordance with the well-settled rule upon that subject." The authorities upon this point are cited in the opinion of this Court in the Harriman case at page 286 (197 U. S.). In view of the decision in the Harriman case and in view of the authorities cited in the opinion of the Court in that case, no question can exist as to the power of this Court to grant the writ of *certiorari* in this suit to con-
120 sider the case upon the merits and dismiss the bill of complaint, if in the opinion of this Court any one or more of the defenses interposed and relied upon is a valid defense.

In *Continental Paper Bag Co.* v. *Eastern Paper Bag Co.* an *interlocutory decree* for an injunction and an accounting in a patent suit was entered by the Circuit Court (142 Fed., 479, 517), and affirmed by the Circuit Court of Appeals as to the injunction (150 Fed., 741). This Court thereupon, on March 11, 1907, granted a writ of *certiorari* (150 Fed., 741).

Thirteenth.—THE ORAL DECISION OF THE CIRCUIT COURT OF APPEALS. 121

In affirming the order for injunction *pendente lite* in this suit, the Circuit Court of Appeals did so by an oral statement delivered upon the argument and as follows:

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE SECOND CIRCUIT.

SUIT ON BERLINER PATENT NO. 534,543.

122

VICTOR TALKING MACHINE COMPANY and UNITED STATES GRAMOPHONE COMPANY,
Complainants-Appellees,

vs.

TALK-O-PHONE COMPANY,
Defendant-Appellant.

In Equity.

VICTOR TALKING MACHINE COMPANY and UNITED STATES GRAMOPHONE COMPANY,
Complainants-Appellees,

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vs.

LEEDS & CATLIN COMPANY,
Defendant-Appellant.

NEW YORK, October 12, 1906.

The Court (WALLACE, *J.*): Mr. Pettit, we can shorten your labors in this case. The Court has

124 examined the record and the briefs of counsel and has reached a conclusion favorable to the appellee upon all questions, save, perhaps, one. It is not customary for this Court, upon the decision of appeals from orders granting preliminary injunctions, to indulge in any elaborate opinion. We generally dispose of those cases without writing an opinion, and we shall dispose of this in that way.

As to the foreign Berliner patents, the German and the French patents, and also the British, we agree with Judge Townsend, first, in the proposition that those patents cover details of construction of the recorder and reproducer and are not for the broad invention of the American patent, the patent
125 in suit. We think, therefore, they are not for the same invention within the meaning of Section 4887. Under Section 4887 it did not, therefore, expire on the expiration of those patents.

As to the Canadian Suess patent, the term of that patent was for eighteen years, as stated, subject, of course, to be defeated by the non-payment of fees after the expiration of six years; but the term of the patent being for eighteen years, the expiration by non-payment after six years did not affect the expiration of the American patent.

Upon the question of abandonment we are of the opinion that the evidence does not warrant any such defense, and it is unnecessary to discuss that defense
126 in detail. And we agree with Judge Townsend throughout in the propositions stated in his opinion.

There is one defense about which we are not entirely clear. That is the defense which rests upon the proposition that by the expiration of the Suess French patent the Canadian patent expired. Of course if the Canadian patent expired, the United States patent expired at the same time. That is a defense which was not raised in the court below, and we are not fully informed about the facts in regard to that defense. We are met with the difficulty that there is no proof in the record of the Canadian law by which, as it is said,

the expiration of the French patent operated to terminate the Canadian patent. Is there any proof of that section of the Canadian statute in the record? 127

Mr. Pettit: Nothing more than the defendant has offered in evidence what purports to be a copy of the Canadian law on that subject.

The Court (Lacombe, *J.*): Where is that?

Mr. Pettit: I am mistaken in saying that. It was not offered in evidence, but it is printed in the record.

Mr. Hicks: It was annexed to the affidavit.

The Court (Lacombe, *J.*): Where is it printed in the record?

Mr. Hicks: At page 181 I set forth the material parts of the patent act of Canada. 128

The Court (Wallace, *J.*): This is a part of whose affidavit?

Mr. Hicks: Of my affidavit.

The Court (Lacombe, *J.*): Where is the clause in your affidavit that refers to this?

Mr. Pettit: I don't think he makes it a part of his affidavit.

Mr, Hicks: Oh, yes. On page 81, folio 243.

The Court (Lacombe, *J.*): All you do, you annex parts of the law of Canada.

Mr. Hicks: Yes.

The Court (Lacombe, *J.*): Material parts of the law of Canada. Well, that is no way to prove the law of Canada in the Circuit Court, by offering an inspection. Is there any testimony by anybody as to what the law of Canada was on the subject. 129

Mr. Pettit: No, sir; there is no testimony on that.

The Court (Wallace, *J.*): Where is the section on which you rely?

Mr. Pettit: Section 8 is not given here.

Mr. Hicks: I rely on the decisions of the Supreme Court.

The Court (Lacombe, *J.*): In the House of Lords?

Mr. Hicks: No; 175 U. S., 187, where the Court held that the Court could take judicial notice of the

130 Navigation Law of Canada and of all laws of sufficient notoriety to be of common interest; and it seems to me the Patent Act of Canada comes within the decision which I have cited on page 31 of my brief in reply.

The Court (Wallace, *J.*): Let us take a memorandum of that. Give us the citation again.

Mr. Hicks: The New York, 175 U. S., 187; 195 to 197.

The Court (Wallace, *J.*): You have not that book in court? Won't you send and get 175 U. S.?

Mr. Hicks: Judge Severens, in 106 Fed. Rep., 215, 218, also said that the Court itself ought to take notice of patent acts of foreign countries,

131 The Court (Wallace, *J.*): What page?

Mr. Hicks: 106 Fed. Rep., 215.

The Court (Lacombe, *J.*): We have held that the presentation of the statute is not sufficient proof of the law of foreign countries, and have stated the reason why.

Mr. Hicks: There was no objection raised in the court below in regard to the laws of different countries.

The Court (Lacombe, *J.*): It was not argued there.

The Court (Wallace, *J.*): You have not assigned any error on that ground.

Mr. Hicks: I understand it to be a general assign-
132 ment of error that the Court erred in granting a motion for a preliminary injunction.

The Court (Lacombe, *J.*): Is the language of this section anywhere on this record?

Mr. Pettit: No, sir; it is not in the record.

The Court (Lacombe, *J.*): You had better send out for it.

The Court (Wallace, *J.*): (Referring to case cited above.) This is a decision in Admiralty.

Mr. Hicks: Yes, your Honor.

The Court (Wallace, *J.*): It is a very different proposition. It was not a court of equity. A court of admiralty may do it.

Mr. Pettit: Your Honor will observe that in my brief I have pointed out the absence of this section of the statute in the record at all, and made objection to it, and further noted that this French patent is not in evidence in this case; was not offered in evidence at all. 133

The Court (Lacombe, *J.*): What—the Suess French patent?

Mr. Pettit: Yes.

The Court (Lacombe, *J.*): That is not in evidence?

Mr. Pettit: No.

Mr. Hicks: It is the same thing as the American patent.

Mr. Pettit: That is incorporated from a stipulation in the Graphophone case; that that French patent was of record in the Graphophone case—not in this case, and was not offered in this case, nor had I any notice that it would be offered until I read the brief. 134

Mr. Hicks: The translation of the French patent was put in evidence, and the evidence shows, by affidavit, that the Suess patent is a translation of the French patent, and that the claims and drawings are identical. Inasmuch as the United States Suess patent is identical with the French patent, is a translation of it—there is the stipulation which was put in evidence here - all the facts in relation to the French patent are in evidence in this suit. There is no dispute that the French patent is identical with the United States Suess patent as to the specifications, drawings and claims. 135

Mr. Pettit: There is a dispute as to the stipulation in the other suit. This matter was not brought up in the court below, and there is a stipulation there in the Graphophone case that I want to explain here if this point is to be considered at all. There was an error in the number in that stipulation. It was admitted by counsel in the Graphophone case. We never stipulated that the Suess French patent was the same as the Berliner United States patent. It

136 is obvious on its face. We have defenses regarding this Suess French patent which we can make here, if we had an opportunity to do it, which would utterly dispose of the French patent; but we have not had that opportunity.

The Court (Wallace, *J.*): Well, we think the point is one which we ought not to consider. In the first place, there is no specific assignment of error. In the next place, it was not raised in such a manner in the Court below that it could be met. In the next place, it is an extremely technical defense and one which the Court should not be very anxious to sustain. In the next place, if it is a good defense it can be introduced by proof and established on final
137 hearing. But the Court is of opinion that it should not reverse this case upon that proposition, even though it should be assumed that a good defense rests upon that ground. That being so, there is nothing to sustain the appellants' contention.

The order is affirmed.

Fourteenth.—THE QUESTION OF THE EXPIRATION OF THE BERLINER-SUESS CANADIAN PATENT, BY REASON OF THE LAPSING OF THE SUESS FRENCH PATENT, DISCUSSED UNDER POINT NINE OF PETITIONER'S BRIEF IN THE CIRCUIT COURT OF APPEALS, IS NOT AVAIL-
138 ABLE, FOR THE REASONS STATED BELOW.

Neither the Suess French patent nor the particular section of the Canadian statute relied upon was in evidence, and it is claimed by complainant's counsel that the French patent had lapsed before the grant of the Canadian patent, and that, therefore, as the French patent did not *exist* when the Canadian patent was granted, the lapsing of the French patent did not affect the Canadian patent under the decision of the House of Lords in *Dominion Cotton Mills Co.* v. *General Engineering Co.*, L. R. App. Cas. (1902), p. 570.

Conclusion.—IT IS RESPECTFULLY SUBMITTED 139
THAT, FOR THE REASONS STATED, THE PETITION FOR THE WRIT OF CERTIORARI SHOULD BE GRANTED.

Dated New York, March 28, 1907.

LOUIS HICKS,
Solicitor for Petitioner.
Office and Post Office address,
71 Nassau Street,
New York, N. Y.

State and County of New York, ss.: 140

EDWARD F. LEEDS, being duly sworn, says: That the Leeds & Catlin Company, the petitioner named in the foregoing petition, is a corporation organized and existing under the laws of the State of New York, and that he is president thereof; that he has read the foregoing petition and knows the contents thereof, and that the same is true to his knowledge, except as to the matters therein stated to be alleged upon information and belief and that as to those matters he believes it to be true.

EDWARD F. LEEDS.

Subscribed and sworn to before me this 6th day of May, 1907. 141

HARRY C. ADAMS,
[NOTARY'S SEAL.] Notary Public,
New York Co.